TROPICAL DISEASES BUREAU.

TROPICAL VETERINARY BULLETIN.

VOL. 6.] 1918. [No. 3.

DISEASES DUE TO PROTOZOAN PARASITES.

SMITH (THEOBALD) & GRAYBILL (H. W.). **Coccidiosis in Young Calves.** —*Jl. Experim. Med.* 1918. July 1. Vol. 28. No. 1. pp. 89–108. With 3 plates comprising 7 figs.

Coccidiosis in cattle has been found to be a by no means uncommon condition in many parts of the world, especially in tropical and sub-tropical countries, since it was first studied in 1892 by ZSCHOKKE and HESS in Switzerland, where it was known as *rothe Ruhr*. Until quite recently, however, the disease does not appear to have been observed in the United States of America. SCHULTZ (1915) undoubtedly recognised its existence among cattle in the north western states. In the prosecution of certain researches upon the diseases of calves in New Jersey Smith and Graybill encountered coccidiosis unexpectedly in association with other diseases. Beyond a microscopic examination of the faeces no detailed study of cases appears to have been made by any observers except ZÜBLIN (1906) in Switzerland, and thus the above two authors undertook a somewhat exhaustive study with the small amount of material available in the course of a small epizootic. Their observations therefore merit notice at some length.

The first case containing coccidia was examined post mortem in April 1917. Other cases followed during the spring and summer. A few coccidia were found in a calf as late as December. The severest, fatal cases occurred in summer. The infection is stated probably to begin soon after birth, and continue over a period of 6 to 8 weeks at the longest, unless death occurs in the meantime from it or some concurrent affection. The characteristic blood in the faeces first occurred in from 3 to 6 weeks after birth and probably when the first group of oocysts was being discharged. In several severe cases, however, blood did not appear in the faeces. There was no evidence of active multiplication of coccidia in cattle older than three months. The disease appeared to exert itself chiefly upon the very young, the older animals having acquired a certain degree of resistance. The infectiousness of the disease did not appear to be very great. Calves were kept together in lots of six or over in small indoor enclosures and were allowed to run together in small yards. Assuming that the oocysts passed in the faeces become infectious within a few days in warm weather there was a striking

(C491) Wt.927/17. 650. 9.18. B.&F.,Ltd. Gp.11/5.

difference in susceptibility of different calves of the same lot. The presence of pneumonia or interstitial nephritis did not seem to exert any influence upon the susceptibility of the animals.

In ZÜBLIN's report the disease was not mentioned to affect young calves. His cases occurred principally in animals at pasture and in one herd of ten cattle, all of which were infected, the ages ranged from six months to two years. According to this observer the first sign of the disease is the passage of blood clots, about 10–15 c.c., in normal faeces by clinically normal animals. One or two days later the blood is more abundant and defaecation more frequent. A case may now return to normal or may grow worse. Usually the older animals recover promptly. In younger animals the quantities of blood passed may increase up to a man's fist in size. The tenesmus becomes more intense and the faeces tend to become thin and foul smelling; the temperature rises, the respirations increase in number, and the appetite is abnormal. From the 5th to the 8th day the admixture of blood in the faeces is replaced by mucus and masses suggesting croupous inflammation of the large intestine. The faeces are watery and putrid. All other symptoms are accentuated and fever is present. With the loss of blood and refusal of food the animal becomes very weak and death occurs often as early as the 7th day. The mortality in ZÜBLIN's cases was 5 per cent. The symptoms in his cases point to septic infection as the probable cause of death. It is obvious that the mortality rate in this disease will depend on the presence of septic organisms in the lesions and their relative degree of virulence, for the coccidia themselves do not cause inflammatory reactions but simply open the way for bacterial infection.

Diagnosis was made by Smith and Graybill by direct examination of blood or mucus when present in the faeces. In cases where the faeces were free from blood and the coccidia could not be detected directly the following method, which is a simplified modification of HALL's method, was adopted by the authors.

"A mass of feces is thoroughly shaken in a closed Mason jar partly filled with water, until well broken up. Then the jar is completely filled with water and the feces are permitted to settle. The water is poured off and the jar again filled with water. The sedimentation, decantation, and washing are continued until the water is nearly clear. In this way the particles lighter than water are removed. The sedimented feces are next mixed in a jar with about enough water to fill a cylinder in which they are to be sedimented and are poured through a tea-strainer held over the cylinder. By stirring the portion of the feces held back in the strainer and by dipping the bottom of the strainer up and down in the water after it nearly reaches the top of the cylinder, oocysts that have been held back are permitted to pass through. After the feces have settled to the bottom, a sample is taken with a pipette of wide caliber, mounted, and examined. By this method a few oocysts were brought to light in normal stools from calves apparently in good health."

No characteristic macroscopic lesions were present in the large intestine. In the more severe cases " congestions and small punctiform haemorrhages were the most definite alterations noticed. The diagnosis will in all cases depend on the microscopic examination of the feces, or on sections of the large intestine, or on both combined."

The parasite. After examination of the oocysts in the faeces it became evident that there were two species of coccidia infesting the calves

The species first encountered and present in large numbers was distinguished by a small oocyst usually elliptical but occasionally ovoid in outline. The wall was double-contoured, uniform in thickness, and as a rule thinner than the wall of the oocyst of the other species. Oocysts were encountered in which the protoplasm completely filled the cyst wall. All stages to that in which the protoplasm was contracted to a circular mass removed from the cyst wall or touching it only at one side were observed. When the protoplasmic mass was well contracted it was located as a rule near the centre of the cyst but sometimes it came in contact with some part of the wall. The cytoplasm contained highly refractile granules of varying size and distributed uniformly or irregularly throughout it. The nucleus was sometimes visible. The length of the oocyst varied from 13·1 to 28·7μ (average 18·6μ), and the width from 12·3 to 20·5μ (average 14·8μ). The evolution of the oocysts was studied by observing their development on the surface of agar plates moistened from time to time with a little distilled water and kept in a moist chamber, at room temperature. The medium consisted of 2 per cent. agar and 0·5 per cent. sodium chloride in distilled water. In this small species with ellipsoidal oocysts four spherical sporoblasts formed; these became elliptical in outline and developed into spores. These spores were elongated, elliptical, circular on cross section and tapered a little at one end. Each spore was surrounded by a thin single contoured membrane which was thickened into a minute cap at the small pole. There was no residual body (*Restkörper*) left behind in the formation of the sporoblasts and there was no residual body in the spore.

Two sporozoites formed in each spore and these were round at the broad end and tapered towards the other end. In one instance the tapering end was seen to be pointed. In the middle of the sporozoites or possibly more frequently in the large end was generally found a rather large, more or less well-defined mass of very minute granules. Elsewhere the protoplasm was homogeneous in appearance. The nucleus was located nearer the broad end and consisted of a small granule surrounded by a halo. The lines separating the sporozoites ran diagonally across the spore. The sporozoites completely filled the spore. The spores did not vary much in size; the few specimens measured varied from 9·9 to 11μ in length, and 5·3 to 5·7μ in width.

The second species, characterised by large distinctly ovoid oocysts, was first encountered in a calf dying in June and subsequently in most cases either in the faeces or in fresh scrapings of the mucous membrane or in sections. The wall of the oocyst was sometimes brownish in colour, sometimes colourless, and was thickest at the broad pole and very gradually diminished in thickness towards the small pole. The difference at the two poles was not great, yet distinctly noticeable. Some cysts occurred, however, in which the wall was uniform in thickness. There was no evidence of a micropyle. The cytoplasm as a rule was contracted into a circular mass located at the middle or in the broader portion of the cyst, occupied two-thirds to three-quarters of the space within the wall, and came almost in contact with the sides; it was filled with large highly refractile granules. The nucleus was not visible. The length ranged from 25·8 to 41·8μ (average 29·9μ) and the width from 16·4 to 24·6μ (average

19·9). In this species the mother sporoblast or oocyst produced four spores without leaving behind a residual body. The spores were similar in appearance to those described in the case of the preceding species with the exception that within each spore was found a large residual body. This body was elliptical or fusiform in shape and lay generally against the wall of the spore, but sometimes in a space formed between the sporozoites, in which case it occupied a diagonal position with respect to the spore; it contained rather large round highly refractile granules of approximately equal size.

The small ellipsoidal form was the numerically predominating type and in a few cases the one exclusively seen. The existence of two distinct species, as alleged by the authors, might be disputed on the ground that considerable variations in size and form are to be found in other single species of coccidia. However, pending further investigation they point out that forms intermediate in both shape and size between the two types of oocysts were not encountered. Also, the presence of a residual body in the large and its absence in the small oocyst is noteworthy. On the other hand, inasmuch as both types from a case might be seen in one field of the microscope the burden of proof rests with the authors.

Studies to determine the exact time required at certain favourable temperatures for the oocyst to undergo maturation were not made. Approximate estimates based on observation of cultures indicated that in midsummer this portion of the cycle in the case of the ovoid type covered about 5 days. Similar estimates indicated a somewhat longer period for the ellipsoidal type. The authors then give a brief outline of the development of the parasite in the mucous membrane of the host. A detailed account is promised later. However, according to their observations nothing was seen suggesting " that the coccidia encountered departed in any significant way from the cycle as mapped out for such a well known coccidium as that of the rabbit."

Careful study of the sections did not enable the authors to distinguish between the above two alleged species in the schizogonic cycle. This may have been due to the relative scarcity of the larger parasite in the material at hand.

As regards the pathology of the disease in the calves the authors state that the seat affected was the large intestine. In the small intestine scattered tubules were found invaded by one or two parasites, rarely by many, even when the large intestine was severely involved. The forms encountered were more often gametes than schizonts. In some tubules sexual and asexual stages were intermingled.

In the large intestine the infection appeared at first in circumscribed foci which tended to grow larger and in some cases coalesce with one another. Usually a certain stage, such as schizogony, prevailed in any one focus. Later both sexual and asexual forms were found together. In the same tubule one might then find fully developed merozoites, macrogametes, microgametocytes, and oocysts. The fertilised oocysts were probably discharged very quickly for they were not abundant in the tubules. Oocysts might be discharged in large numbers in the faeces while schizogony was going on. Not infrequently there were found scattered empty shells of oocysts in the connective tissue between tubules infected with the schizogonic forms; these remains of oocysts probably represented aberrant forms

which had failed to become discharged into the lumen of the intestine in the course of an earlier infection.

The relative immunity of the small intestine as compared with the large intestine is noteworthy. In rabbits and birds (sparrows, hens, turkeys, and pheasants) the principal seat of invasion is the small intestine and the large intestine and caeca only become secondarily involved. Other facts of interest are the self-limitation of the disease in a number of cases and the apparent complete immunity of some calves penned with severe cases.

With regard to the lot of calves observed by the authors brief details are given with regard to 8 cases affected with coccidiosis and terminating fatally; six calves passed blood clots containing large masses of oocysts and subsequently recovered completely; seven other calves in the same lot remained unaffected and samples of faeces concentrated before examination by washing and sedimentation did not reveal any coccidia.

In these cases of coccidiosis the ill effects upon the host may be attributed to, first, the local lesions and, secondly, to systemic disturbances caused by the entrance into the circulation of infective agents through the injured intestinal epithelium. With regard to the local lesions the changes set up by the early invasion of the epithelial cells are insignificant. The host cells retain their normal appearance except in point of size and inflammatory reactions are absent. When the parasites have become widely diffuse and occupy most of the cells a number of changes are evident. Under a low power the tubules are no longer normal in form and some appear to be missing; under a high power the disappearance of the tubules is seen to be due to the loss of the lining epithelium surrounding each tubule and the invasion of the lumen with cellular elements, mostly polynuclear leucocytes. The surface epithelium is also attacked and small masses of leucocytes, fibrin, and red blood corpuscles cling to the denuded surface in places and indicate the source of the haemorrhages. These masses have embedded in them many oocysts. The masses of blood in the faeces are thus produced by the conglomeration of many small haemorrhages from the capillaries near the surface of the intestine, and this explains why the source of the blood is not macroscopically evident on post-mortem examination.

A further lesion found in advanced stages is a complete necrosis of a limited patch of mucous membrane involving up to ten or more tubules. In this focus the cell nuclei have either completely disappeared or are broken up into fragments or pyknotic; the cytoplasm takes a distinctly reddish tint with eosin.

Owing to the frequent occurrence of pneumonia associated with the coccidiosis in the cases studied the injuries other than local could not be definitely ascertained. A specific kind of organism considered to be a probable etiological factor was discovered in most of the cases of pneumonia.

Up to the end of May 1918 only one case of bloody dysentery was subsequently observed in the above herd. This occurred in a calf over 11 months old; the coccidia found in the faeces were of the smaller, elliptical type; the symptoms readily disappeared.

HAUGHWOUT (Frank G.). **Infections with Coccidium and Isospora in Animals in the Philippine Islands and their Possible Clinical Significance.**—*Philippine Jl. Sci.* 1918. Mar. Vol. 13. Sec. B. No. 2. pp. 79–93. With 5 text-figs.

In this paper the author enters into a general discussion with regard to the organisms usually spoken of as coccidia. He reminds the reader that all these organisms do not necessarily belong to the genus *Coccidium*, this genus constituting only one of a large number of genera grouped together within the order Coccidiidea. This order is divided up by LEGER into four families—Asporocystidae, Disporocystidae, Tetrasporocystidae, and Polysporocystidae.

The two genera considered particularly in this paper are the genus *Isospora* (family Disporocystidae, in which the oocyst contains two sporocysts), and the genus *Coccidium* (family Tetrasporocystidae, in which the oocyst contains four sporocysts).

Recently the Department of Medical Zoology received material that apparently represented six different kinds of coccidial infection, viz., (1) an organism found in the kidney of a guinea-pig, probably identical with SEIDELIN'S *Klossiella cobayae*, a member of the family Polysporocystidae; (2) a coccidial infection of undetermined nature in the testis of the house lizard; (3 & 4) a Coccidium and a species of Isospora in the intestinal tract of the house lizard; (5) *Isospora bigemina* in the intestine of kittens; (6) *Coccidium cuniculi* in the rabbit, believed by many to be identical with the coccidian parasite that has been reported in man.

The author deals with the question of the specificity of the various species of coccidia found in animals and particularly with regard to the possibility of their being infectious for man. Up to the present it appears that 34 well-authenticated cases of human coccidiosis have been recorded, but the specificity of the parasite found in these cases has not been established.

A few preliminary notes are given with regard to the above coccidia. The Coccidium from the intestine of the lizard was usually oval in shape, sometimes spherical; the oval oocysts measured 20μ by 16μ, while the spherical ones measured from 19μ to 20μ in diameter, which brings them rather close in point of size to the measurements recorded by WENYON for his human Coccidium. The oocysts of *C. cuniculi* ranged from a length of 33μ to 49μ by 15μ to 28μ in breadth.

Measurements of a few oocysts of the author's cat Isospora showed a variation in length of from 29μ to 38μ and in breadth of from 22μ to 29μ, all the cysts being oval. It is stated that these figures do not wholly coincide with the measurements of oocysts, of presumably the same species, made by other workers. STILES (1892) reports measurements of from 24μ to 40μ in length and from 19μ to 28μ in breadth, while SWELLENGREBEL gives a length of from 39μ to 47μ and a breadth of from 26μ to 37μ.

CLARK (Herbert C.). **Piroplasmosis of Cattle in Panama.**—*Jl. Infect. Dis.* 1918. Feb. Vol. 22. No. 2. pp. 159–168.

Towards the middle of the construction period of the Panama Canal the Hospital at Ancon organised a dairy and stocked it with

animals from the United States, chiefly from the Gulf coast region. A number of pigs and a considerable number of chickens were also imported and subsequently the enterprise grew to such proportions that it required more space and was removed to a neighbouring village where it is now known as the Corozal farm. A few cases of tuberculosis were found in the imported cattle, a condition which is never found in the native cattle. In addition, contagious abortion and other conditions common elsewhere were at times encountered among these animals. Hog cholera also made its appearance.

It was noted that the calf mortality was higher than is usually to be expected in well cared for stock. Clinical and post-mortem examination failed to explain the number of deaths among the calves and although piroplasmosis was suspected the presence of the disease could not be demonstrated. The development of the Hospital Dairy encouraged local cattle owners to take up dairy farming on a more intensive scale and they thus imported Holstein and Jersey cattle for cross breeding with native stock. These imported animals soon became sick and many of them died. Piroplasmosis was again suspected but no piroplasms could be demonstrated by careful examination of blood films. The acute outbreaks of this disease were studied by DARLING in January 1915 and in his report he stated that the clinical picture of the disease in the imported animals was that of "Southern cattle fever," but examination of blood films from one animal after death revealed only some anaplasma-like bodies. At the close of the construction period of the Canal large pastures were cleared along its course for the purpose of receiving imported cattle and pigs in order to furnish a meat supply.

In November 1916 two calves, six and ten months old respectively, from the Hospital Farm were received in a moribund condition and examined post-mortem. The hides of both animals were tick infested and both were affected with intense anaemia and emaciation, but showed no sign of jaundice or haemoglobinuria. In the case of one animal there was no marked change in the spleen, there was parenchymatous degeneration in the liver, kidneys, and heart muscle, but no petechiae on any of the serous membranes. Films stained by Hastings' modification of the Romanowsky method from various organs and the blood showed a sparing number of *Babesia bigemina*, chiefly in the bone marrow of the rib, and the crushed grey matter of the brain cortex.

In the case of the other calf the spleen was on the other hand enlarged, and its capsule was tense and pulp soft, oozing, and purple. All the serous membranes contained areas of ecchymoses and there was extremely acute parenchymatous degeneration. Films from the various organs in this case all revealed *B. bigemina* but those made from the grey matter of the brain cortex and the ganglionic matter at the base of the brain showed the organisms in greatest abundance. These preparations showed capillaries that appeared to be stuffed with paired pyriform bodies. Some of these films were sent to Theobald SMITH, who confirmed the belief that the parasites were *B. bigemina*.

Subsequently, four weak emaciated tick-infested calves were obtained from another pasture of the Supply Department and kept under observation for from a few days to three weeks. They had

fever but did not show the typical curve of the acute disease. Blood films were examined each morning and evening and in one case a few parasites were revealed in the peripheral blood as well as in preparations made from a female tick engorged with blood. No jaundice or "redwater" was noted in these calves while under observation but the haemoglobin content of the blood showed on an average a reduction of 50 per cent. Piroplasmosis was ultimately diagnosed post-mortem. All very sick animals in this particular pasture were now located and kept out of the herd. Tick eradication, along the lines employed in the Gulf coast region of the United States, was then instituted. The ticks were reported to be of the species *Margaropus annulatus australis.* Twenty-five more animals were in the meantime taken away from the herd; all were calves from six to ten months of age except two old native cows. Films from the brain, spleen, marrow and blood of the above 29 cattle thus obtained from this pasture gave the following results as regards the presence of *B. bigemina.*

	Positive.	Negative.
Brain films	29	0
Marrow film, rib	10	19
Spleen films	8	21
Blood films	3	26

The calves so far examined were born on the Isthmus and most of them were calves of native cows served by an imported bull. They had been exposed to tick infestation since birth. The constant presence of the parasite in these animals indicated that a latent type of the disease may be common among the cattle outside the Canal zone and in order to elucidate further this point the author undertook to examine brain films from an unselected series of prime beef animals immediately after they had been killed at the abattoir. The method of examination and results obtained were as follows:—

"Three or four blows with an axe, hatchet or machete just behind the horns will expose the brain, and as a rule the dura and the brain are not badly lacerated. A piece of the gray matter of the brain cortex about the size of a split pea was selected, placed on a glass microscope slide near its middle, another slide being used to crush it so that a film extends over half the slide. By increasing the pressure as one drags the material toward the ends of the slide it is possible to leave a film that is thick at the middle of the slide and thin at the end. At some place in the preparation networks of blood-filled capillaries will be found. The film is quickly dried and then stained as soon as possible in some polychrome blood stain. When ready for examination use low magnification to find some well defined thin areas containing capillaries, and then a high magnification. The capillaries can then be traced for blood cells containing parasites. Many times the first field of capillaries examined in the slaughter-house revealed one or more parasites. The average time spent in searching in a particular case was 3 minutes, although some of the cases required 20-30 minutes.

"The beef cattle of Panama came from all parts of the cattle region of the Republic. They were examined in lots of 20–25 just in the order that the authorities chose to kill them without regard to age or degree of tick infestation. Every animal of the 125 examined showed *Babesia bigemina* and in spite of a rather fair degree of infection in some offered no clinical sign of the disease.

"The supply department imports a similar class of animals from Colombia which are slaughtered at Cristobal. An examination of 150 of these showed that 90 per cent. were carriers of the same parasite.

"Other opportunities have been taken to examine cattle of all types in outlying regions as well as in the basin of the Chagres river as far up the river as inhabitants are to be found. In all localities the disease was present. Native cattle suffering serious injury, long periods of starvation, etc., develop piroplasmosis, at least their examination showed an abundance of parasites.

"It appears from these results that almost all the cattle of Panama and Colombia must be considered as carriers of the parasites of piroplasmosis. Since no protective measures are employed against the disease and since the tick in this locality continues an almost uninterrupted cycle of development throughout the year, all cattle born here are exposed to the infection from the time of their birth on. It is well known that calves survive the disease better than the fullgrown cattle that have not had the disease in their early life, nevertheless, it is possible that this disease partially explains the high death rate in calves in this country. The animals that do survive the calf period certainly acquire an immunity that protects them from future attacks provided injury, starvation, or some intercurrent disease does not undermine the vitality. The importation of non-immune cattle, when not followed by protective measures, is surely followed by considerable loss. Generally speaking, the native cattle (although hardy animals) do not fill out into the fat sleek animals commonly found outside a tick belt."

The author then discusses the pecularities of piroplasmosis in Panama cattle. Acute cases as a rule occur in non-immune imported cattle; many adult animals of this class are lost but a fair percentage of the calves survive. The clinical picture of the acute disease is like that described by SMITH and KILBORNE. Native animals suffer acute attacks when they are subjected to starvation, injury or an association of diseases. In the chronic form the animal appears wasted, anaemic and dull-looking with a tick-infested hide. Jaundice and haemoglobinuria are not often noted and the temperature curve is not characteristic. Carriers of the parasite may not show a single sign of the disease but usually they do not become large fat animals.

From the original report of SMITH and KILBORNE it appears that these authors only examined the brain in four of their cases and in these they found great numbers of the parasites in the pia mater, choroid plexus, and the brain substance. Since these were probably acute cases this organ did not impress them as a suitable one for routine examination. In both the acute and chronic forms of the disease there is a marked reduction in the haemoglobin. In other parts of the world from one to ten per cent. of the corpuscles in the peripheral blood are said to be invaded. The strange feature concerning the disease in Panama is that in no more than eight or ten cases was the author able to find the parasite in the peripheral blood even in acute cases, and he adds that the delayed identification of the disease in this region may be attributed to the extreme scarcity of the parasite in the peripheral blood and to the fact that brain examination was neglected. In acute cases in imported stock the author was able to confirm SMITH and KILBORNE'S observations with regard to the large percentage of corpuscles infected in the capillaries of the internal organs especially of the kidneys, but, nevertheless, the brain always revealed them in greater abundance and "when chronic cases and carriers are to be examined at necropsy or in the abattoirs the system of brain capillaries takes precedence over all others."

"It is reasonable to suppose that organs with intricate capillary systems favour the presence of such parasites, but the capillaries in the kidney, heart muscle, liver, spleen, etc. do not lend themselves readily to the

preparation of films free of debris and which offer a sufficient number of intact corpuscles."

The description of the parasites found in the brain closely corresponds with that given in the classical accounts. A greater variation in the size and morphology of the parasite was found in the films from the rib. Single pyriform types and comparatively large irregular round forms were infrequently seen. The types seen in the peripheral blood of a few acute cases consisted of single pyriform bodies larger than one of the paired forms found in the brain, "So few 'anaplasma-like' bodies were found in the blood films and their position was so inconstant that it is unsafe to say that the bodies really represent parasites." The average size of the typical pyriform bodies found in an acute case in the brain measured 3·6 by 1·8*μ*.

The following animals were inoculated with the defibrinated blood from beef cattle known to be carriers of *B. bigemina*: 4 guinea-pigs, 1 donkey, 2 pigeons, 1 monkey, 3 opossums, 2 young dogs, 1 mule, 1 goat, and 2 non-immune calves. The calves developed the disease but no results were obtained in any of the other animals.

Moreover, additional investigations showed that native cattle in Panama acted as hosts in almost every case not only of *B. bigemina*, but also of filaria, sarcosporidia, and a large trypanosome probably of a harmless type. Two cattle harboured a spirochaete probably *S. theileri*. In Panama piroplasmosis has thus hitherto been found in the horse, cattle, deer, and dog.

GRIFFITHS (J. A.). **A Note on Piroplasmosis of the Donkey.**—*Jl. Comp. Path. & Therap.* 1918. June. Vol. 31. Pt. 2. pp. 131–133.

The author's observations were made in the North Nyasa district of Nyasaland and in the New Langenburg and Iringa districts of German East Africa. Piroplasmosis in the donkey has already been recorded by SCHELLHASE in German East Africa [see this *Bulletin*, 1914, Vol. 2, No. 2, p. 64] and by other observers in various parts of Africa. The disease appeared to affect more severely the white Zanzibar donkey and crosses of this breed with the native grey donkey; the latter breed appears to have a high degree of natural immunity. In its most common form the disease runs a chronic course and the number of parasites in the blood is small and varies daily. Usually not more than one per cent. of the corpuscles are invaded in a fairly heavy infection; exceptionally four per cent are attacked. In the chronic cases the parasites are often difficult to find.

The parasites vary considerably in shape—amoeboid, round, ring and match shaped forms have been noted at different periods during the course of an attack, in the order mentioned. Pear-shaped parasites were rare, occasionally parasites were seen in pairs, these being either leaf-shaped or match-like forms, and in several cases, where the parasites were joined at the extremities away from the nucleus a small granule of chromatin was seen at the junction. The nucleus, which is usually found towards the periphery in the amoeboid, round, and ring forms, is in these cases much smaller than in the pear-shaped and match-like forms where it consists of a darkly-stained, irregularly rounded mass at one end of the parasite. No cross forms were observed. Free parasites were seen in the plasma during the course of acute infections. The smaller round forms of the parasites

resembled cocci in appearance and were almost invariably placed towards the periphery of the corpuscle.

Clinically the affected animals show, in the chronic form of the disease, the symptoms of anaemia; the animal becomes dull and listless, the mucous membranes are pale and there is gradual emaciation with progressive weakness. There is no febrile reaction. A rise of temperature would indicate some secondary infection. During an acute attack the temperature may rise to 104–105° F. and a common complication in these cases is broncho-pneumonia. Where the disease is secondary to a cylicostome infection a fairly high mortality (25 per cent. in two years) may be observed.

The period of convalescence is always very prolonged in emaciated cases. Many animals recover but always remain in poor condition. Trypanblue did not appear to exercise any beneficial effect in treatment. Careful attention to dieting is recommended in order to assist the animal's natural powers of resistance; iron preparations and nux vomica are useful in chronic cases, as adjuncts to a liberal diet.

LAVERAN (A.). **Infections du loir par *Leishmania tropica* et par l'agent de la leishmaniose naturelle du chien.** [Infections of the Dormouse with *L. tropica* and with the Causal Organism of Natural Canine Leishmaniasis.]—*Bull. Soc. Path. Exot.* 1918. June. Vol. 11. No. 6. pp. 445–448.

From his experiments on a number of dormice Laveran concludes that these animals are much more resistent than white mice to the virus of natural canine leishmaniasis. As in the case of white mice it was also to be noticed that the infections due to canine leishmaniasis and those due to *L. tropica* exhibited quite different characters. Canine leishmaniasis set up fatal visceral changes whereas *L. tropica* produced local lesions (in the testicular region) followed by recovery. Testicular lesions were noted in the case of the dormice inoculated with the canine virus but compared with the changes in the liver, spleen, and bone marrow they were very slight.

VELU (H.). **La trypanosomiase des chevaux du Maroc. Essais du traitement.** [Equine Trypanosomiasis in Morocco. Experiments on Treatment.]—*Bull. Soc. Path. Exot.* 1918. June. Vol. 11. No. 6. pp. 448–451.

During the course of a serious outbreak of trypanosomiasis occurring in 1916 among the horses of a native cavalry unit (125 affected out of a total of 178) Velu was afforded an opportunity of testing the action of several chemical products that appeared to have given encouraging results in the treatment of similar affections. The affected animals were kept under observation from July 1916 to July 1917. Eighty-six died and the remaining 39, presumably cured, were for military reasons allotted to various units and hence their subsequent history could not be traced. During the first quarter of the year 1917 these latter horses owing to special care and attention were kept in condition at a Remount Depot, but it was found quite impossible to put them to work requiring severe exertion; in June 1917 in spite of their apparent good health they were absolutely incapable of keeping up with other horses on the march.

In these experiments the affected animals were divided into lots as similar in condition as possible and control animals were also selected in the same conditions. Moreover, in the case of some drugs the author administrated for purposes of comparison massive doses to one series and numerous fractional doses, collectively exceeding a single massive dose, to another series. The products utilised were generally not employed alone but associated with other drugs and had to be administered intravenously on account of the irritation set up by subcutaneous or intramuscular injection.

The operation of intravenous injection requires great care owing to the fact that the vein may become traversed especially in the case of restive animals and thus a few drops of a solution of novarsenobenzol, for example, set up a very marked painful swelling in the perivascular connective tissue. Instead of using needles the author employed a small exploratory trocar, the canula of which could be adapted to fit an ordinary injection syringe. The length of the canula was 5 cm., external diameter $1\frac{3}{4}$ mm., internal diameter $1\frac{1}{2}$mm. After having inserted the whole length of the trocar and canula into the jugular, perforation of the opposite wall of the vessel then becomes impossible when the trocar is withdrawn from the canula. Within $2\frac{1}{2}$ months more than 1,000 intravenous injections were made in this way with only a single accident. The results of the treatment are indicated in the following table :—

Series.	Products employed.	No. of horses treated	Poisoned.	Natural death.	Total mortality.	Horses surviving over a year.
1	Atoxyl-Orpiment, massive doses	10	7.	1	8	2
2	Atoxyl-Thiarsol Clin. ..	5	3	0	3	2
3	Atoxyl-Tartar emetic, massive doses	10	2	6	8	2
4	Tartar emetic, massive dose, Arsenicals, small dose ..	6	1	4	5	1
4B	Ibid.	5	0	2	2	3
5	Tartar emetic-Thiarsol Clin., massive doses	5	3	1	4	1
6	Tartar emetic-Galyl, small doses	5	0	4	4	1
7	Tartar emetic-Orpiment ..	5	5	0	5	0
8	Tartar emetic-novarsenobenzol	5	0	3	3	2
9	Tartar emetic, small doses. Arsenicals, small doses ..	5	0	3	3	2
9B	Ibid.	6	0	1	1	5
10	Novarsenobenzol, massive doses	5	0	2	2	3
11	Galyl, massive doses ..	5	0	3	3	2
12	Antimony trioxide	4	0	2	2	2
13	Controls, 1st class	6	0	4	4	2
14	Controls, 2nd class	6	0	0	0	6

If one leaves out of account series 7, where all the horses were poisoned by the administration of commercial orpiment, and series 9b and 14 composed of horses in which the disease was not recognised until the months of October or November it will be seen that the results obtained are strictly comparable in all the series including the control series 13. The various methods of treatment employed did not seem to have any action upon the course of the disease. Animals in a very advanced stage of the disease and those in an emaciated condition were much more sensitive to toxic doses than those in which the body condition had become but little diminished. It could be generally stated that all subjects severely affected and depressed before treatment died from intoxication caused by doses of the drug that only produced slight or even no untoward effects upon the less affected animals.

The following statements are given with regard to the action of the various drugs.

(1) Atoxyl, thiarsol, and tartar emetic in massive doses exerted a somewhat pernicious influence, hastened on the onset of death in the case of animals in low condition, and did not cure the others.

(2) Galyl, and novarsenobenzol in large dozes did not set up such immediate ill effects as would lead one to suspect the same pernicious influence.

(3) Arsenicals of all kinds appeared to give the best results when given in small repeated doses with the object of maintaining the strength of the animal and thus enable it to combat the causal organism.

[One would have been able to form a better opinion as to the value of the above important and summarily described piece of work if the protocols of the experiments had been appended.—Ed.]

Laveran (A.). **Grande fréquence de la kératite chez les chiens infectés par *Trypanosoma marocanum*; un cas de kératite ulcéreuse double.** [The Great Frequency of Keratitis in Dogs Infected with *T. marocanum*; a Case of Double Ulcerative Keratitis.]—*Bull. Soc. Path. Exot.* 1918. May. Vol. 11. No. 5. pp. 375–379.

As is well known, trypanosomiases are often accompanied in certain animals such as dogs, rabbits, goats, and horses by eye changes, characterised principally by opacity of the cornea. These changes have been described by Morax (1907). In the course of his study of *T. marocanum* Laveran was struck with the frequency and severity of keratitis in infected dogs. The Moroccan virus was obtained from two sources, viz., Casablanca and Mazagan (see this *Bulletin*, Vol. 6, No. 1, pp. 6–7). Velu observed opacity of the cornea in ten dogs out of 31 inoculated with the Casablanca virus. Delanoë noted the same complication in one dog out of three inoculated with the Mazagan virus. In his experiments the dogs used by Laveran probably were more resistent than those used by the above authors. Three dogs inoculated with the Casablanca virus showed lesions of keratitis in all cases. The first dog, which died 39 days after inoculation, showed complete opacity of the left cornea; the second dog also died 39 days after inoculation, showing opacity of the right cornea and haziness of the left cornea. In the case of the third dog dead 80 days after inoculation the keratitis became ulcerative in character during the last stage of the disease and one cornea perforated. This constitutes

a rare form of trypanosome keratitis and a similar case has already been described by MORAX.

Out of five dogs inoculated with Mazagan virus four died with opacity of the cornea, complete in the case of three, and incomplete in the fourth. The dog dead with transparent corneae succumbed 24 days after inoculation whilst in the case of the other four dogs the course of the infection varied from 47 to 146 days. The short duration of the disease in the first of these dogs explains the absence of corneal lesions at the time of death; a few days before death this dog, however, was affected with double conjunctivitis which seems to indicate that the eyes were about to become infected when death supervened. The three dogs that died with both corneae entirely opaque succumbed in 47, 65, and 54 days, respectively. The dog that showed incomplete opacity of the cornea at the time of death succumbed 146 days after inoculation, but in this case an attempt at treatment produced a distinct effect upon the course of the disease and upon the corneal changes.

ITURBE (Juan). **El emético en el tratamiento de la derrengadera.** [Tartar Emetic in the Treatment of *Derrengadera.*]—*Gac. Méd. de Carácas.* 1918. Mar. 31. Vol. 25. No. 6. pp. 62–63.

The favourable results obtained after the use of tartar emetic by VAN SACEGHEM (1915) in the case of Congo cattle infected with *T. cazalboui*, and also by various authors in the case of human cutaneous and visceral leishmaniases induced the author to test the action of this drug on the trypanosomiasis of horses known on the plains of Venezuela as *derrengadera.*

Some preliminary experiments were first made on guinea-pigs artificially infected with virus obtained from the "plains" horses. After a number of passages a strain of virus of uniform virulence was obtained capable of causing death in the guinea-pig 10 days after intraperitoneal injection. In the tests of the drug guinea-pigs showing innumerable trypanosomes in the peripheral blood were always used. It was found that a dose, administered intramuscularly or intravenously, of from 4 to 5 milligrammes per kilo. body weight, caused the disappearance of the trypanosomes from the peripheral blood constantly within 15 minutes. No recrudescence of infection for several days after the treatment was found on examination of the blood; also blood withdrawn from an animal a week subsequent to treatment failed to set up the disease in a healthy guinea-pig. In some instances, however, relapses were observed on the third or fourth week after the first treatment, but these were found to yield to repeated injections of the drug. The dose of drug should be increased in the case of a very heavy trypanosome invasion. The laboratory animals were found to show a large degree of tolerance to the drug administered subcutaneously or intravenously. No accidents occurred in the course of the experiments. Although the trypanosomes in the peritoneal blood may be completely destroyed by a single injection of the drug it is known that those found hidden in the deeper tissue channels away from the circulating blood may remain quite unaffected. Repeated injections of the drug are therefore necessary in order to inhibit relapses.

Solutions of the drug were sterilised in the cold by passing through a Berkfeld filter. Encouraged by the results obtained in the course of the above experiments on laboratory animals the author endeavoured to perform some tests on horses affected with the natural disease. Five horses and two mules showing typical symptoms of the disease and large numbers of parasites in the peripheral blood were injected regularly every five days. The drug was administered intravenously in 1 to 1·50 gram doses dissolved in 100 c.c. of 0·4 per cent. common salt solution. No accidents occurred and all the animals recovered. It was found that the drug could be given even in 1 : 40 solutions without accident and with excellent therapeutic effect. Treatment of *derrengadera* on a large scale by means of tartar emetic is now being carried out.*

VAN DEN BRANDEN (F.). **Essais de traitement de la trypanosomiase humaine par l'émétique huileux.** [Treatment of Human Trypanosomiasis by Means of Oily Suspensions of Tartar Emetic.]—*Bull. Soc. Path. Exot.* 1918. May. Vol. 11. No. 5. pp. 379–382.

Suspensions of tartar emetic were made in olive oil, earth nut oil and liquid paraffin; the last-named product gives rise to a poor suspension. The drug was administered intravenously in 4 per cent. concentrations. No pain was experienced at the seat of injection in the patients treated but all suffered from a violent cough lasting from 15 to 30 minutes after the injection. This cough was less intense in subjects injected with the drug suspended in paraffin. As the result of his experience in nine cases the author concludes that oily suspensions of tartar emetic do not present any advantages over a watery solution of the same product, either from the point of view of therapeutic

* There appears to be a good deal of uncertainty concerning the identity of this disease. Translated literally from the Spanish the term *derrengadera* would be taken to refer to a condition of paresis or paraplegia affecting the hind quarters, and thus would be synonymous with the better known South American trypanosomiasis designated as *mal de caderas*, caused by *T. equinum*. According to LAVERAN and MESNIL [Trypanosomes et Trypanosomiases, 1912] a disease known as *desrengadera* affecting all classes of Equidae, dogs, and some wild animals on the Venezuelan plains was first studied by Rafael RANGEL in 1905. This author claimed that the equines of Venezuela were affected with only one type of trypanosomiasis, which, however, became clinically manifested in two principal forms:—(1) Progressive pernicious anaemia (*peste boba*), with oedematous swellings (*hermosura*); (2) paresis or paraplegia (*desrengadera*). He concluded from a study of the symptomatology that the disease was identical with *mal de caderas*, although, as LAVERAN and MESNIL state, the presence of oedematous swellings has not been described in the case of that disease; moreover, RANGEL did not consider that the presence of a well marked centrosome was an important factor for differentiating the causal organism from *T. equinum*. "Mesnil (1910) was enabled . . . to study a few smears of infected blood and convince himself that the Venezuelan trypanosome is morphologically different from *T. equinum*. It resembles *T. evansi* of surra. A fairly considerable variety of forms is seen, especially from the point of view of size: the average dimensions are 18 to 23μ by 1.7μ; but, certain elements reach up to 30μ." *T. equinum* measures 22 to 24μ long by 1.5μ broad. "Mesnil proposes, until fuller information is obtained to designate RANGEL'S trypanosome by the name *T. venezuelense*. "In addition to the resemblance with the surra organism, there is strong reason for instituting a comparison with *T. hippicum*, discovered by Darling in 1910 in the Equidae of Panama."

effect or in respect of the tolerance of subjects for large doses (pharmacodynamic action). The violent cough manifested immediately after the injection, the danger of intoxication as soon as one reaches doses that should prove efficacious, and the evident inefficacy of such high doses in a certain number of cases constitute sufficient evidence for rejecting this method of administering the drug from current practice in the treatment of human trypanosomiasis.

[Compare with the results obtained by VAN SACEGHEM (R.) and NICOLAS (E.) in the treatment of animal trypanosomiasis with tartar emetic in the Congo (see this *Bulletin*, 1917, Vol. 5, No. 1, p. 21).]

TEAGUE (Oscar) & CLARK (Herbert C.). **A Trypanosome of Panamanian Cattle and a Method for Concentrating Trypanosomes in Peripheral Blood.**—*Jl. Infect. Dis.* 1918. Feb. Vol. 22. No. 2. pp. 154–158.

The authors showed that a large percentage of cattle brought to Panama City from various parts of the Republic of Panama harbour a large trypanosome in their blood. This trypanosome could not be found in smears made directly from the blood but developed in cultures grown at 26° C. In order to demonstrate its presence two c.c. of freshly drawn defibrinated blood were added to 10 c.c. of nutrient broth containing 0·85 per cent. sodium chloride. After 24 to 48 hours incubation the trypanosome could usually be detected in the upper layer of the sediment. On the third or fourth day they were generally present in large numbers occurring in clusters with flagella extending outwards and the posterior ends embedded in a central clump of leucocytes. The trypanosomes remain alive and actively motile in these cultures for 30 days or longer. After a few days, however, marked changes in morphology occurred, with the appearance of crithidial forms, some oval flagellated bodies and spermatozoon-like forms. In order to study the morphology of the organism as it occurs naturally in the blood the following method of concentration was adopted.

"The freshly drawn blood is whipped with wooden sticks in an enamelware cup and the defibrinated blood is poured through wire gauze to remove bits of fibrin. Ten c.c. of the blood are added to 10 c.c. of distilled water, and the two are thoroughly mixed. This was done at the slaughter house. Hemolysis of the red cells takes place in a few minutes. As soon as we reached the laboratory the blood was centrifugated, the supernatant fluid was poured off and the sediment was emulsified in the two or three drops of fluid remaining. Smears from this sediment showed well preserved trypanosomes in almost every instance, from 1–10 or 12 or more to a slide having been found. A drop of the sediment examined under a cover-slip occasionally showed a trypanosome, which remained actively motile for more than an hour after the distilled water had been added to the blood. There is a distinct advantage in defibrinating the blood before laking the red cells, as a smaller amount of distilled water is required, and the sediment after centrifugation seems to be smaller in amount."

The trypanosome was subsequently found in large numbers in the blood of a calf that had been inoculated seven days previously with a large dose of cattle blood. The trypanosome agreed in point of size and morphology with the descriptions given of *T. theileri*. On an average the organisms were about 45μ long (exclusive of flagellum) by 3·5μ wide, with a flagellum about 14μ. The posterior end was long,

drawn out, and pointed. The undulating membrane was well developed, the blepharoplast was round and generally situated one quarter the length of the body of the trypanosome from the posterior end. The nucleus stained well and was centrally placed. The organisms found in a calf showing large numbers in its peripheral blood as the result of artificial infection were smaller in size than those seen in the case of cattle suffering from a chronic infection. The authors failed to infect a guinea-pig, a monkey, a pigeon, and a chicken with young cultures of the trypanosome, and, moreover, blood of cattle containing the trypanosome also failed to infect four guinea-pigs, one chicken, two pigs, one monkey, three opossums, one goat, and one mule, thus showing that failure to infect with young cultures was not due to loss of virulence. On the other hand a calf about four months old developed large numbers of the organisms in its blood 12 days after inoculation with the blood of cattle known to harbour the trypanosome; a little over three weeks later blood smears, however, gave negative results.

Filaria were also readily demonstrated in the blood of Panama cattle by the above-described concentration method although they could very rarely be found in ordinary blood films.

LANFRANCHI (A.). **Su di un nuovo genere di parassiti del sangue.** [A New Genus of Blood Parasite.]—*Ann. d'Igiene.* 1917. Nov. 30. Vol. 27. No. 11. pp. 697–699. With 4 text-figs.

In 1908 the author described a specific disease of pigeons produced by a haematozoon which he placed in the family of Mastigophora. On further examination of his preparations and drawings he considers that this parasite presented considerable morphological resemblances to the organism recently described by MARTOGLIO as occurring in the blood of a fowl in Eritrea, and placed by that author in a new genus—*Haemotrichomonas* [see this *Bulletin*, Vol. 6, No. 1, pp. 8–9]. The method of multiplication, however, apparently differed somewhat from that described by MARTOGLIO in the case of his parasite, which was said to multiply by longitudinal fission. In the parasite found in the pigeon multiplication appeared to take place by a process of schizogony. The nucleus divided into a number of small masses which migrated towards the periphery of the protoplasm of the mother cell; the protoplasm then became compacted around each small nuclear mass so as to produce a rosette-shaped appearance just before final division. The parasites studied by MARTOGLIO showed no evident pathogenicity. Lanfranchi's organism, however, was highly virulent for the fowl and also for rabbits and guinea-pigs. The author believes that MARTOGLIO was justified in creating a new genus for Trichomonas inhabiting the blood and thus the organism found to infest the pigeon is named *Haemotrichomonas columbae.*

LEISHMAN (William B.). **A Note on the "Granule-Clumps" found in *Ornithodorus moubata* and their Relation to the Spirochaetes of African Relapsing Fever (Tick Fever).**—*Ann. Inst. Pasteur.* 1918. Feb. Vol. 32. No. 2. pp. 49–59. With 2 figs.

In 1908 the author obtained a number of *Ornithodorus moubata* from Nyasaland and Uganda with a view to studying the course of

events in tick fever in experimental animals. After several failures he eventually secured a batch of ticks which proved to be infective and by their bites produced in a monkey a typical attack of relapsing fever associated with the occurrence of large numbers of *Spirochaeta duttoni* in the blood. This strain of spirochaetes has since been maintained in mice by means of inoculation or by the bites of infected ticks. In previously published papers (1909–1910) the author thus dealt with the fate of spirochaetes ingested by the ticks, the nature of the hereditary transmission of the infection in the tick, and the mechanism of infection by the bite of the tick.

The present note records recent observations tending to lend still further support to the author's contention that some at least of the granule clumps almost constantly found in various tissues of the tick and in the eggs of the ripe female are derived from spirochaetes and are able subsequently to regain their original spirochaete appearance. These clumps would therefore represent a stage in the development of the spirochaete in the tick. It was found that spirochaetes after ingestion by the tick retained their motility for several days, the period depending chiefly on the temperature at which the ticks had been kept. Subsequently they lose their motility and tend to agglomerate into masses which, when stained, are seen to consist of spirochaetes the chromatin in which has broken up into a number of deeply staining segments or granules. Others, however, behave differently and develop a lateral or terminal body which then apparently separates and corresponds to an isolated granule clump. Still later there occurs a period of a few days during which either no spirochaetes at all can be detected or only rare ones that are seldom motile. Next, and especially in the case of ticks that have been kept at comparatively high temperatures, there appears a sudden re-infection of the tissues with numerous and vigorously motile spirochaetes, often very different in size and general appearance from those that were originally ingested by the tick. These so-called young forms are very much shorter than the others, the smallest being from 3 to 4μ in length and showing only two or three curves.

In the course of several experiments it was found that this second group of spirochaetes disappeared more or less completely and six or seven days later a repetition of the above events occurred; in other words, regular relapses appear to take place in the body of the tick as regards the appearance and disappearance of spirochaetes, just as in the case of the warm blooded host.

DISEASES DUE TO METAZOAN PARASITES.

Schwetz (J.). **A Comparative Study of the Habits of *Glossina brevipalpis*, Newst., *G. fusca*, West., and *G. pallidipes*, Aust. in the Belgian Congo.**—*Ann. Trop. Med. & Parasit.* 1918. May 11. Vol. 11. No. 4. pp. 365–398. With 1 map & 1 chart.

Comparatively little is known about the habits of *Glossina fusca* and *G. pallidipes* although those of *G. brevipalpis* have been more fully investigated; the lack of knowledge may be explained by the

comparative rarity of the former species. However, according to the author, where *G. fusca* occurs it is frequently not at all uncommon but still it does not swarm in such large numbers as *G. brevipalpis*. *G. pallidipes* also may be found in large numbers, sometimes almost as great as those of *G. morsitans* when one has obtained knowledge regarding the habits of the species. It has been stated that *G. brevipalpis* is much restricted in its distribution but the author's observations suggest that it is in reality to be found over large tracts of country. The observations recorded in this paper were made for the most part in the Agricultural Station of Katompe where there are coffee plantations. This station (in the Province of Katanga, Tanganika-Moere District) is situated almost midway between the river Lualaba and the river Lomami, slightly south of the 6th S. parallel and about 26° 50. E. long. Three months (February to April 1916) were devoted to the work and the observations made were controlled and completed by expeditions taken to the same district:—(1) from Katompe district to Kabalo and return; (2) Katompe to Kongola; and (3) Kongola to Kabinda. All the observations were made during the rainy season, circumstances preventing observation during the dry season. In previous articles on *G. morsitans* and *G. palpalis* the author has insisted upon the importance of the various types of vegetation in determining the distribution of tsetse flies in general and one or another species in particular. The main types of tropical African vegetation may be grouped in three classes:—(1) forest; (2) woods or park land; and (3) savannah, and the last-named class may be sub-divided into grassy savannah and wooded savannah. These types are not sharply separated from one another and areas exist in which the vegetation is intermediate or transitional in type, so that qualification of the above terms is sometimes necessary in describing a particular spot. It has previously been pointed out by the author that although all tsetse require shade and are therefore never found in the stretches of grassy savannah different species require different kinds of vegetation. Thus *G. morsitans* only occurs in park land while *G. palpalis* is only found near water bordered with forest. The investigations recorded in this paper were undertaken, however, in order to discover, *inter alia*, the types of vegetation necessary for *G. brevipalpis*, *G. fusca* and *G. pallidipes*; whether these flies are capable of adapting themselves to any kind of arborescent vegetation—be it forest park or wooded savannah, or whether all or any of them require one of these three types. A further object also was to determine the importance of water as a factor influencing their distribution.

The distribution of the flies and the vegetation of the various regions are traced on the map and chart given.

The following summary and conclusions to his investigations are given by the author.

(1) "The five important tsetse-flies—*G. brevipalpis*, *G. fusca*, *G. pallidipes*, *G. morsitans* and *G. palpalis*—select tree trunks, the larger branches of trees and lianes for resting purposes.

(2) "In regions where they exist, *G. brevipalpis* and *G. pallidipes* are not restricted to limited areas or belts, but, like *G. morsitans*, are found uninterruptedly—except in large clearings— over vast stretches of country.

(3) "The habits of *G. pallidipes* are intermediate between those of *G. brevipalpis* and *G. morsitans*. Like *G. brevipalpis*, *G. pallidipes* hovers

over the ground when active and is usually so only at certain fixed times, especially between 3 p.m. and 5 p.m. (4 to 6 p.m. with *G. brevipalpis*), the maximum activity being reached about 4 p.m. The habits of *G. pallidipes*, however, are less well defined than those of *G. brevipalpis*, and it not only appears and bites more often than the latter, but is not uncommonly seen on the wing in very small numbers throughout the whole afternoon and occasionally in the forenoon. Of the *G. pallidipes* captured when active, only about 15 per cent. were females.

(4) "In those regions where *G. brevipalpis* occurs it accommodates itself to all types of arborescent vegetation—forest, park land and wooded savannah, but *G. pallidipes*, like *G. morsitans*, does not inhabit the forest.

(5) "*G. fusca* occurs only in one kind of arborescent vegetation—forest. As the region where these observations were made (northern Katanga, notably the districts between the River Lualaba and the upper Lomami River) consists of park land and savannah, the forest only being represented, usually along rivers and streams, by belts of varying width, it is evident that in this region *G. fusca* only occurs in limited and somewhat restricted areas. Further, these areas are still more restricted owing to the fact that this species only inhabits moderately dense forest belts of a certain width (200 to 300 metres). But contrary to what has been thought so far, where *G. fusca* does occur it is not at all uncommon, and sometimes it is quite abundant. However, it has peculiar habits—it does not fly during the day like *G. morsitans* and *G. palpalis*, it does not hover over the ground at definite times like *G. brevipalpis* and *G. pallidipes*, but always remains motionless on tree trunks and lianes. Occasional specimens, usually one or two, are sometimes attracted by men and animals passing by. These may make their appearance at any time of the day, but prefer the cooler hours, e.g., early in the morning or more often late in the evening. But *G. fusca* also has a definite period of activity, viz., from 7 to 8 p.m., or one to two hours after sunset, and if a haunt of the fly be passed during this time numerous attacks are sure to be made.

(6) "Females of *G. fusca*, unlike those of *G. brevipalpis* and *G. pallidipes*, are commonly found, and form nearly 50 per cent. of the specimens captured—whether the flies be taken on the wing or resting on trees, etc.

(7) "Since forest belts usually occur near water, it is in the neighbourhood of the latter that *G. fusca* is generally found, but *G. fusca* also occurs in forest belts where there is no water in the immediate vicinity, and may even be found in forest a few kilometres distant from the nearest water In this respect, therefore, *G. fusca* is unlike *G. palpalis*, but resembles *G. pallidipes*, *G. brevipalpis* and *G. morsitans*.

(8) "The haunts of *G. brevipalpis*, *G. pallidipes* and *G. fusca* are situated almost exclusively along the roads and paths."

The following figures illustrate the proportions of the sexes of the various tsetse flies :—

(1) "Of 165 specimens of *G. fusca* captured at Katompe in February (a few of which were taken on the wing), 88 were males and 77 females.

(2) "Of 255 specimens of *G. fusca* captured at Katompe in March, 143 were males and 112 females.

(3) "Several species of tsetses captured one morning on tree trunks between Masembi and Musinga Lenge were divided as follows :—

(*a*) 27 *G. brevipalpis*, 21 males, 6 females.
(*b*) 4 *G. pallidipes*, 3 „ 1 „
(*c*) 7 *G. fusca*, 4 „ 3 „

(4) "Of 344 *G. pallidipes* captured at Katompe from February to March, 281 were males and 63 females.

(5) "Of 237 *G. pallidipes* captured on the Katompe-Kabalo route in February, 193 were males and 44 females.

(6) "Of 509 *G. morsitans* captured on the same route during the same journey, 304 were males and 205 females.

(7) "Of some 5,000 *G. brevipalpis* captured at Katompe and elsewhere, only 50 were females, and of these about 75 per cent. were captured on tree trunks."

DUNN (L. H.). **Studies on the Screw Worm Fly, *Chrysomyia macellaria* Fabricius in Panama.**—*Jl. Parasit.* 1918. Mar. Vol. 4. No. 3. pp. 111–121.

The screw worm fly occurs in great abundance throughout the Canal zone and the Republic of Panama, and owing to its dangerous habit of depositing its eggs on living as well as on dead tissues of man and the lower animals is of considerable economic importance. The number of eggs laid in one batch by a single fly varies considerably but in favourable circumstances averages 190. On dead animal matter the females show a tendency to lay their egg masses together in a heap. The time required for the eggs to hatch varies from 11 to 23 hours, the average being about 14 hours. Surrounding conditions of moisture and the temperature exert very little influence inasmuch as they are nearly always the same in Panama, though the time may be shortened owing to the action of the body heat when the eggs are deposited on living tissues. The growth of the larvae is very rapid, approximately 2 mm. a day until they become mature on the 5th or 6th day. The pupal period usually lasts from 4–5 days and among the emerging adults there is little disparity between the sexes. The adult flies exist on fluids or semi-fluids in material that can be reduced to a semi-liquid food, such as the garbage found near habitations and decaying plant and animal substances in the woods and jungle.

The females seem to prefer the late afternoon or evening to deposit their eggs but it is not known whether they remain active after nightfall in search of suitable places. Most flies become inactive at nightfall, but this species has been observed to deposit its eggs during the night while in captivity and when gravid females are captured and placed in breeding jars they lay their eggs much more readily if the jar is covered with a dark cloth than if it is left uncovered. In Panama the fly seems to be entirely impartial in its choice of environment; the females are very active, always searching either for food or for a place to lay their eggs, and in the jungle they are quickly attracted by any animal, probably by its odour.

Throughout the Isthmus of Panama this fly by means of its larvae causes a greater amount of damage and suffering to cattle, horses, and other animals than any other dipterous pest and, if one excludes the disease bearing mosquitoes, the same remark applies to man. The disorders caused by the larvae in man are described at length.

Nearly all kinds of domesticated animals and some of the wild animals are subject to attack by this fly. It has recently been discovered that it will deposit its eggs in the nostrils of perfectly healthy dogs. In one case observed in a deerhound considerable damage was done by their eating through the tissues surrounding the nostrils into the mouth; the dog recovered after removal of the maggots, but it was subsequently found that they had caused a loss of bones in the upper right half of the mouth and nose, loss of teeth in the upper right jaw, and partial or complete loss of smell. The dog was of no further use in hunting owing to the loss of its sense of smell. The screw worm may be classed as an important enemy to dogs on the Isthmus, not only owing to the loss of tissue brought about directly by it but also on account of the secondary bacterial infections which often follow attacks of myiasis and cause death.

On account of their persistent habit of licking all wounds within reach cats are seldom infested, but one cat was observed with two fully grown screw worms in an open wound situated just behind the ears. The worms have also been found on neglected spur wounds on fighting cocks. Three tame deer kept at the laboratory became infested from very insignificant wounds. One male became attacked as the result of a skin abrasion caused by tying a rope around the horns. The second one became infested as the result of a small punctured wound near the hock produced by a nail; the external opening remained very small but a deep cavity formed underneath which was found to contain 52 larvae. The third deer developed maggots on a small wound on the nose caused by running against the fence.

If an animal dies and is left unburied for a few hours it is evident that many eggs become deposited within the natural orifices and also if time is given for the eggs to hatch the cavities will contain many young larvae that will be buried with the carcase. Even if the eggs are not hatched before burial their hatching is delayed but little and the young larvae emerge as readily underground as on the surface. Experiments performed in order to investigate the depth at which the larvae may be buried and emerge from the surface as adults showed that 56 per cent., mostly females, emerge when buried at a depth of 2½ feet, the flies appearing on the surface from the 10th to the 14th day after burial. The author states that when the carcases of dead animals are buried it is seldom that they are covered with more than 2½ feet of earth. The percentage of flies that would emerge when the carcase was buried at a smaller depth would be proportionally greater.

There is as yet no positive evidence incriminating this species of fly as a disease-transmitting agent, but research in this direction is necessary, especially as regards the transmission of anthrax among cattle. In localities where the screw worm flies are numerous they are seen attracted to an animal dead of anthrax. In such cases they are found either feeding on the discharged fluids on the ground or about the head of the animal, or are busy depositing their eggs about the natural orifices or other places where there is sufficient discharge to produce a moist surface. In Panama the buzzards locate the body of an animal soon after death and after a few of these scavengers start feeding on a carcase it presents better opportunities for the flies. The author gives as an illustration the facts with regard to the carcases of three steers dead of anthrax observed by him on a pasture.

"They had been dead only a few hours but had began to bloat and a strong odor of decomposition was emanating from them. A veritable swarm of screw worm flies was feeding and ovipositing on each carcass although they were nearly a mile apart. When these flies either feed or oviposit on a carcass the feet and proboscis must necessarily become contaminated and . . . are capable of infecting any animal that they may visit shortly after; that is, providing the animal happens to have a fresh brand mark that is unhealed, cuts from barbed wire, horn wounds, or any skin abrasions . . . this fly may be one of the principal carrying agents in tropical and sub-tropical countries."

With regard to preventive and control measures tests were made with different drugs in order to determine their respective lethal

effects upon the screw worm. The most effective agents were fat solvents which readily penetrated and dissolved the fatty tissue of the larvae. Owing both to the great diversity of the breeding habits of this fly and owing to the peculiar conditions existing in Panama but little can be said with regard to its control.

In treating animals with infested wounds all open lesions may be sprayed with chloroform or carbon tetrachloride to remove the maggots. Both of these substances have proved efficacious. Carbon tetrachloride is quite as fatal to the maggots as chloroform, it is equal in penetrating power, it does not evaporate any more readily, it produces no more irritation to the tissues, does not retard healing any longer, and is much cheaper. Carbon tetrachloride does not attract the flies by its odour as the carbon bi-sulphide is said to do and it is not inflammable like the latter substance. Deep punctured wounds are best treated by first spraying with glycerine in order to cause the maggots to become more active and approach the external orifice of the wound. They may then be sprayed with carbon tetrachloride to destroy them. If one of the lethal fat solvents is injected into a deep wound in an undiluted state the larvae are apt to be destroyed *in situ* and subsequently cause suppurative changes. After a wound on an animal has been rid of all screw worms it should be dressed with some repellent agent such as pine tar to keep the flies from depositing more eggs on the wound. The author strongly recommends as a protective dressing a mixture of equal parts of beeswax, fish oil, and carbon tetrachloride, with enough vaseline added to give it the proper consistency. If all animal wounds, both those which are fresh and those from which the screw worms have been removed, are painted with this mixture it will prevent the flies from depositing their eggs and save the cattle from damage as well as reduce the number of flies. The author then gives instructions with regard to the prevention of myiasis in the human subject.

Dove (W. E.). **Some Biological and Control Studies of *Gastrophilus haemorrhoidalis* and other Bots of Horses.**—*U. S. Dept. Agric.* Bull. No. 597. 1918. Apr. 9. 52 pp. With 5 plates & 4 text-figs. (Professional Paper.) 1918. Washington: Govt. Ptg. Office.

"Three species of horse bots—the common bot-fly (*Gastrophilus intestinalis*), the throat bot-fly (*G. nasalis*), and the nose fly (*G. haemorrhoidalis*)—occur in the United States, and each is a source of considerable injury to horses. This injury is produced through worriment caused by the flies at the time the eggs are laid and by the attachment of the larvae, or bots, in the alimentary tract.

"*Gastrophilus intestinalis* and *G. nasalis* are widely distributed in the United States but *G. haemorrhoidalis* is confined to the North Central and northern Rocky Mountain States.

"The nose fly (*G. haemorrhoidalis*) is by far the most annoying to horses at the time its eggs are laid. The adults appear early in June and reach the maximum of abundance during the first half of the season, disappearing with killing frosts. The eggs are deposited on the minute hairs on the lips, and those near the edges which are kept moist and receive friction hatch in from 5 to 10 days. The larvae are taken in with food or water and attach themselves to the walls of the stomach. Here they remain until the following winter or spring and then migrate to the rectum, where they reattach. Before leaving the host they usually attach close to the anus and protrude from it. They remain in this position from 40 to 71 hours. After dropping to the ground the bots seek protection

and pupate in from 18 to 170 hours later. The pupal stage lasts from 21 to 68 days. The adults are very active, and as they deposit only one egg at a time they are not so frequently seen about horses as are the adults of the common bot-fly. They take no food in the adult stage. Their length of life is from 1 to 7 days.

"The throat bot-fly (*G. nasalis*) deposits its eggs on the hairs under the jaws and to some extent on the shoulders and other parts of the host. The larvae of this species attach themselves to the walls of the pharynx and also to those of the stomach and duodenum. They do not reattach in the rectum or at the anus as do the bots of the nose fly. Pupation occurs in from 1½ to 2 days after the larvae have passed from the host, and adults emerge in from 20 to 56 days later. The adults are somewhat longer lived than those of the nose fly. The flies cause considerable annoyance to horses during oviposition but not as serious as in the case of the nose fly.

"The common bot-fly (*G. intestinalis*) usually appears later in the season than the nose fly and becomes most abundant just before killing frosts. The eggs are deposited on all parts of the body, but preferably on the fore legs. They hatch upon the application of moisture and friction. From 9 to 11 days after oviposition appears to be the most favorable period for hatching, although some may hatch as early as 7 days and others as late as 96 days after oviposition. The larvae attach in any part of the stomach, but the last-stage bots are found mostly in the left sac. They continue to drop from the host for a long period of time. Pupation takes place in protected places on the surface of the soil and the pupal stage lasts from 40 to 60 days.

"All Gastrophilus larvae are surprisingly resistant to chemicals. The treatment of horses with carbon disulphid in three doses followed by a physic is satisfactory if administered in the late fall. Spring treatment is less effective, as the full-grown larvae are more resistant, and many of the nose-fly bots have left the stomach and passed back to the rectum at that time.

"Larvae of *G. haemorrhoidalis* may be removed from the rectum mechanically, but this is laborious. The use of enemas containing insecticides is ineffective.

"As a repellent, pine tar mixed with other material gave good results against the common bot-fly and the throat bot-fly. Such mixtures may be utilized to cause the flies to lay eggs on parts of the body less accessible to the horse's mouth.

"Various nose protectors are in use against *G. haemorrhoidalis*, but there are objections to many of them. A piece of leather suspended below the lips from the bit rings is simplest and best. For animals on pasture a halter with a box-like arrangement and throat cover has been devised to protect horses against infestation by all three species.

"Kerosene oil used as a wash is ineffective in destroying the eggs of Gastrophilus, but certain other substances have given good results. Carbolic acid containing 2 per cent. phenols is satisfactory for destroying eggs when applied to the infested parts of the host."

LAMSON, Jr. (G. H.). **The Life-Histories of the Cattle Lice.**—*Jl. Econom. Entom.* 1917. Aug. Vol. 10. No. 4. pp. 446–447.

"The life-histories of these species have been worked out during this winter. Ten specimens of the short-nosed ox louse (*Haematopinus eurysternus*) were placed on a restricted region on the shoulder of a Holstein calf that was less than twenty-four hours old. The white eggs were soon laid. These were observed once each day and the eggs hatched in from seven to eight days after they were laid. These young were removed and placed on another calf and these laid eggs in from fifteen to sixteen days after hatching, making a life-cycle of from twenty-two to twenty-four days. The female of this species lays from thirty-five to fifty eggs each. The life-history was checked on other calves.

"The life-history of the long-nosed ox louse (*Haematopinus vituli* Linn.) was very similar though it was slightly longer. The method used was the

same as in the previously mentioned louse. These insects were placed in a white patch where the shining black eggs hatched in from eight to nine days and the lice again laid eggs in from seventeen to eighteen days after hatching, making a life-cycle of from twenty-five to twenty-seven days.

"The little red biting lice (*Trichodectes scalaris* Nitz) have been much harder to determine owing to the difficulty in keeping them confined. From the writer's observations supplemented by the hatching of eggs in an electric incubator it is believed that they hatch from the eggs in from five to six days and mature in two weeks though more work must be done on this species to determine its life-cycle with the accuracy of the two previously mentioned species. This would indicate that a treatment might be repeated with the best results from ten days to two weeks after the first treatment.

"The experimental work on the control measures will appear in the future in a bulletin from the Storrs Experiment Station."

HERMS (William B.). **Contribution to the Life-History and Habits of the Spinose Ear Tick**, *Ornithodoros megnini.—Jl. Econom. Entom.* 1917. Aug. Vol. 10. No. 4. pp. 407–411.

A description of habits, life history, and conditions set up by the above tick in the Union of South Africa has already been noticed at some length in the preceding number of this *Bulletin*, [Vol. 6, No. 2, pp. 84–85, BEDFORD (G. A. H.)], and measures for its eradication were outlined. According to Herms

"the Spinose Ear Tick presents a problem of considerable importance to the animal husbandryman in nearly all of the southern half of California, particularly in the Imperial Valley, where calves become seriously infested and die from what the ranchers call 'Tick Fever.' Experiments and field observations on this species have been carried on more or less continuously by the University of California Laboratory of Parasitology during the past three or four years. From our records it would seem that few, if any, warm blooded animals coming within reach of this tick are exempt from attack. Calves evidently are most liable and suffer most severely, many dying from the effects.

"Infested calves shake the head vigorously, become emaciated, often race about madly until completely exhausted. The ears become inflamed and the secretion of wax is greatly stimulated. Deafness is said often to result in infested horses and mules."

An account is given of a case in which a man became infested through sleeping on the ground at night alongside cattle ranges or pastures. The tick almost certainly entered the man's ear as a larva and about nine weeks later a fully grown female was extracted from the auditory meatus. The man had complained of intermittent noises in the affected ear. The female remained alive without food at room temperature for nearly a year.

In order to ascertain the exact time expiring between the last moult and the deposition of eggs a number of females that had not undergone their final moult were placed in Petri dishes with one or two males and kept in an insect cage at 26 $\pm$ 3° C. One of these females, after about 60 days, was subjected to a temperature as low as 0° C. It was found that copulation took place readily within a day or two of the last moult and that in six cases egg deposition began in from 14 to 42 days after copulation or from 15 to 44 days after the last moult, the number of ova varying from 7 to 562. The longest period of oviposition noted was 155 days, or 189 days after moulting.

A few experiments were made in order to find the length of the incubation period. It was found possible to secure oviposition during the winter months (November and December) under laboratory conditions and the eggs were found to hatch at a room temperature of about 21° C., requiring from 18 to 23 days incubation. Under field conditions this, however, takes place during the summer and autumn months.

In a series of experiments in which the larvae were kept in darkened receptacles at room temperature, during the months of November, December and January, it was found that the range of longevity was from 19 days, the shortest, to 63 days, the longest, with an average of 44 days. This series included seven sets of larvae hatching during a period of 32 days.

THOMSON (F.). KEOGH (F.) & TUCKER (George). **Eradication of the Cattle Tick. Observations on the Efficacy of the Tick-Destroying Mixtures Approved by the Queensland Stock Department, According to the Method and the Thoroughness of their Application.**—*Queensland Agric. Jl.* 1917. Dec. Vol. 8. Pt. 6. pp. 302–307. With 1 table.

The Queensland cattle tick *Margaropus* (*Rhipicephalus*) *annulatus australis* is a one-host tick spending the whole of its parasitic life, approximately 21 days, on one animal. Under favourable weather conditions the fully engorged tick commences to lay eggs in 3 days after dropping off from its host and in from 10–21 days it may lay from 15,000 to 3,000 eggs. The eggs hatch in from 21–42 days and owing to the small size of the larvae an early infestation is easily overlooked and a susceptible cow may die of redwater before the ticks are sufficiently grown to be readily detected. On the other hand the further development of the ticks on immune animals furnishes the means of propagating the infection. Highly successful results have been obtained in Queensland for about 20 years by dipping cattle in fluids containing 0·2 per cent. of arsenic (8 lbs. of arsenic per 400 gal. of water containing emulsifying agents). There has been a tendency among stockowners of late years to reduce the amount of arsenic, to substitute spraying for dipping, and neglect to have samples of dip properly analysed. The authors briefly describe some experiments in which the difficulty of killing off the ticks by means of even careful spraying is demonstrated. After 12 months experience with this method it was concluded that spraying occupied too much time and was not sufficiently reliable to enable one to maintain a pasture absolutely clean. Consequently a dipping tank was installed for experimental purposes.

A dip was prepared according to the Department's formula as follows:—

Commercial arsenic	8½ lbs.
Caustic soda	4 ,,
Stockholm tar	½ gallon
Water	400 gallons

The dipping vat at working level held 2,800 gal. and was charged as follows:—2,000 gal. of water were run into the vat; 59½ lbs. of commercial arsenic were mixed with 14 of caustic soda in the dried

state and placed in a 400-gallon tank with about 20 gal. of water, the mixture being stirred for a few minutes until the ingredients boiled and the arsenic dissolved. Cold water was then added until the tank was full when the mixture was well stirred and run into the dip. Next 50 gal. of water were run into the tank and heated to boiling point; 14 lb. of caustic soda and 28 lbs. of tallow were then added and boiled together for ¾ of an hour. Cold water was then gradually added, the heating being continued but the fluid was kept below boiling point. When the tank was half full 3½ gal. of Stockholm tar were added and the mixture well stirred. Heating was continued and water gradually added until the tank was full, when the mixture was thoroughly stirred and run into the dip. The whole of the contents of the vat was then thoroughly stirred and used for dipping cattle. Dipping of all cattle running in the paddocks was performed every 14 days with highly satisfactory results, no discomfort being experienced by the animals either in summer or in winter. The results of five carefully conducted experiments to demonstrate the efficacy of this method for tick eradication are indicated in the table.

The authors' conclusions are as follows:—

"**There is a very striking difference in the efficacy of tick-destroying fluid according as this is applied by dipping or spraying. Spraying is so unreliable that its use for treating tick-infested or suspected cattle before travelling into clean country should not be countenanced when a suitable dip is available. If spraying is unavoidable, the cattle should be sprayed as often as necessary and held in a clean place until they are proved by the most careful inspection to be clean, and the inspector examining same should be sufficiently experienced to realise the great difficulty of detecting the presence of a very limited number of ticks, more especially when the hair is long.**"

VAN SACEGHEM (R.). **Contribution à l'étude du** *Gastrodiscus aegyptiacus* **(Cobbold 1876).**—*Bull. Soc. Path. Exot.* 1918. May. Vol. 11. No. 5. pp. 396–397.

The study of the above parasite was undertaken by van Saceghem at the Bacteriological Laboratory, Zambi, Lower Belgian Congo. The eggs were easily found in quite fresh faeces from horses and were of large size, 150–170μ long by 90–95μ broad. No segmentation can be observed within the egg after oviposition, except in the centre where a polyhedral mass may be seen. At laboratory temperature (average 28° C.) the egg contents after three weeks become very granular in appearance. The presence of humidity is by no means necessary. Segmentation can take place equally well in a dry environment. The central mass inside the egg soon undergoes retraction which is very marked at the two poles. A few days later a small vermicule can be distinguished showing intermittent movements inside the egg. The vibratory movements of the cilia can be quite well seen. The anterior extremity of the ciliated larva is found opposite the micropyle of the egg. The obstruction at the opening is then found to give way and the larva escapes into the outside world. If the necessary amount of humidity is not available the miracidium quickly dies. On the other hand this stage shows rapid translatory movements in water; if an obstacle bars its way the ciliated larva throws itself into a ball and progresses by means of creeping movements. The morphology of the Gastrodiscus miracidium is similar

to that of any other miracidium. The ciliated larva is 164μ long by up to 73·8μ broad. The anterior extremity is blunted, whereas in the case of *Fasciola hepatica* it is pointed.

The question arises as to whether there is a certain intermediate host in which the miracidium develops into sporocysts. If one takes into account the large number of horses infested, the rapidity with which the parasite becomes distributed throughout a country, and the enormous number of Gastrodiscus that may be found in the intestine of horses one may conclude that the miracidium gains easy access to large numbers of the intermediate host; this consequently must be very common and is probably a mollusc found in abundance in marshy land. As a rule the infection produced by *Gastrodiscus aegyptiacus* does not give rise to any serious symptom. However, in certain circumstances, especially when the horses are debilitated as the result of some disease or insufficient food, the parasitic invasion may bring about serious complications and progressive anaemia, leading finally to death. Horses badly infested frequently show signs of colic, which disappear after the administration of a dose of laudanum to which is added some ether. There is no specific treatment against the infection. Arsenic even when administered in large doses does not cause the amphistome to disappear. The only means of preventive treatment that can be adopted is to prevent horses from drinking water from marshes and to forbid the use of grazing land in their vicinity. Also, horses should not be fed in the stable with fodder cut close to the marshes.

RAFFENSPERGER (H. B.). **Experiments in the Transmission of Trichinae.**—*Jl. Amer. Vet. Med. Assoc.* 1918. June. Vol. 53. (New Ser. Vol. 6.) No. 3. pp. 363–367.

"In the literature of trichinosis, statements are occasionally seen that infection may be brought about by the ingestion of feces or the intestinal contents of animals harboring the intestinal stage of the parasite. From time to time the results of experiments have been recorded which it is claimed demonstrate the transmission of the parasite in this way. Höyberg (1907) for example concluded that infection may result from the swallowing of feces or intestinal contents of infested animals, and recently Salzer (1916) reported infection from feeding the feces of infested dogs. Various highly competent investigators, however, including such well-known authorities as Leuckart and Pagenstecher have reached the conclusion that infection cannot be brought about through the swallowing of intestinal trichinae or the newly born larvae which may occasionally be found in the feces of animals during the time when adult trichinae are present in the intestine. A few years ago, Stäubli (1909) reported a series of experiments in feeding to white rats the intestines of rats and guinea-pigs containing trichinae in various stages of development and his results were consistently negative."

In the course of investigations upon trichinae undertaken by the writer under the direction of the United States Bureau of Animal Industry some experiments similar to those of STÄUBLI were carried out and negative results were likewise obtained in all cases.

"Concerning the stage at which trichinae in the muscles become infectious it is usually stated in the literature that non-encysted trichinae are not infectious. Leuckart (1860) fed a dog with muscles of a young girl containing trichinae none of which so far as observed were yet encysted. After seven days the dog was killed and its intestine was found to contain trichinae. He therefore concluded that encystment is not a necessary

condition for the further development of Trichinella. It is questionable, however, whether there might not have been also encysted trichinae present in the muscle fed. Pagenstecher's experiments (Pagenstecher, 1865) throw more light on the subject, since he gives definite information concerning the age of the trichinae which he fed. Trichinous rabbit meat seventeen days after artificial infestation of the animal from which it was taken was fed to rabbits which were killed within 24 days and found to be free from trichinae. Trichinous meat from a mouse 15 days after artificial infestation failed to produce intestinal trichinosis in a rabbit which was killed 4 days after feeding. Similarly, pigs escaped intestinal trichinosis after eating rabbit meat 14 days after artificial infestation. However, another pig was fed on rabbit meat 18 days after artificial infestation and when killed 9 days after feeding was found to contain small intestinal trichinae, the males measuring 0·9 mm. and the females 1·75 mm. in length. In one experiment he reports a successful infestation of a rat as a result of feeding mouse meat 15 days after artificial infestation. The rat was killed 4 days after feeding and was found to contain in the intestine 3 females with a maximum length of 1·45 mm. and 2 males. He also observed that copulation has already taken place. This experiment is open to objection, however, since the same mouse had been fed on trichinous meat about three weeks previous to the infestation on the basis of which the age of the infection was computed. Pagenstecher after killing the mouse concluded that the first infestation must have been unsuccessful since he found only unencapsuled trichinae in the muscles. It is not unlikely, however, that the muscles contained encysted trichinae from the first infection, which were overlooked, and that it was these which developed into the adults found in the rat.

"Goujon (1867) states that as a result of feeding trichinous meat containing non-encysted trichinae he succeeded in producing light infestations in various animals. He admits the possibility that some of the trichinae may have been encysted and concludes that the infestations produced as a result of eating meat containing unencysted parasites are much lighter than those which follow the eating of meat containing encysted trichinae."

A small number of rabbits and guinea-pigs were fed by the author with trichinous meat and killed at various intervals after feeding. The diaphragm and in some cases portions of other muscles were subsequently fed to other rabbits or guinea-pigs which were killed after certain intervals and examined as to the presence of trichinous infestation. The results showed that no infection was produced by feeding meat containing unencysted trichinae taken from animals killed 15, 17, and 18 days after infection, respectively, but infection resulted from meat containing newly encysted trichinae taken from an animal killed 21 days after infection.

"The evidence obtained from the experiments supports the generally accepted opinions that trichinae are not transmissible through the feces, that unencysted trichinae are not capable of development when meat containing them is ingested, and finally that trichinae are spread from one host to another only as a result of the swallowing of meat containing the encysted larvae of the parasites."

Lewis (J. C.) & Seddon (H. R.). **Habronemic Conjunctivitis.**—*Jl. Comp. Path. & Therap.* 1918. June. Vol. 31. Pt. 2. pp. 87–92. With 2 text-figs.

In their introduction the authors state that in Australia "the occurrence of Habronema in the skin and subcutaneous tissues has appeared of recent years to be more common or, at least, it has been much more frequently noticed, and may be assumed to be becoming more widespread or more various in its manifestations, and probably of more importance in its effects."

"As mentioned in Railliet's report [see this *Bulletin*, 1916, Vol. 4, No. 3, pp. 102–105] Ercolani was the first to discover in 1859 a larval nematode (*Habronema megastoma?*) in the subcutaneous fibrous tissue of some of the skin lesions which in the horse are generally known as summer sores or granular dermatitis. Others, including Buffard, Rivolta, Fayet, and Moreau, have also described similar conditions. In India a somewhat similar condition is often confused with other cutaneous lesions caused by moulds, and possibly other agents, under the general term bursati. More recently the work of Descazeaux [*see* also passages of *Bulletin* referred to above], on Esponja or Summer Sores of Equines in Brazil has been the subject of the report by Railliet mentioned above.

"Bull [this *Bulletin*, 1916, Vol. 4, No. 4, pp. 166–168] has described at length, under the term habronemic granulomata, a somewhat similar condition which is usually situated about the urethral orifice and the sheath of equines; in one instance lesions were also present in the metacarpal region, and in another on the hock."

One of the authors (Lewis) described in 1914 equine granuloma in the Northern Territory of Australia (swamp cancer), which condition is considered by BULL to have the same histological picture and to be "almost certainly a variation of the same condition" described by himself.

The authors then give details regarding four cases of the above condition. The lesions in these cases were as follows:—(1) a granulomatous mass involving the inner canthus of the eye and the membrane; on closer examination fine miliary necrotic areas were found on the conjunctiva of the lower lid; a year later a similar condition recurred in both eyes. (2) Small yellow necrotic areas on the membrana nictitans and the conjunctiva of the lower lid of both eyes. (3) Many small whitish scars producing some puckering on the conjunctiva. The necrotic areas had probably been absorbed. (4) Granulomatous mass presenting small caseous areas some of which were partly extruded from the surface at the inner canthus, numerous whitish scars over the membrana nictitans; a tumour was also present on the shoulder about the size of a hen's egg with numerous discrete shot-like masses around its periphery. The lower lid was also oedematous in these cases and lachrymation was marked in two of them.

The lesions on section were found to contain minute yellowish areas of necrotic tissue varying greatly in shape; the spherical masses measured about 0·25 mm. in diameter, the cylindrical-shaped ones 3 mm. in length by 0·5 mm. in breadth. The necrotic foci lay in soft vascular fibrous tissue. The majority of these masses on being broken up on a slide showed no parasites within the subcutaneous areas, but on teasing out these areas in saline under the microscope it was found that some of them did contain parasites. The parasites lay in canals within the areas and were usually slightly curved or twisted; usually not more than one parasite was found in each necrotic mass. In the second case mentioned above no recognisable nematode parasites were discoverable while in the third case no microscopic examination was possible. The shoulder lesion in the fourth case also presented small necrotic areas on section. Histological examination of the earliest lesions showed that the parasites occurred primarily in the lymph spaces where they gave rise to a small-celled infiltration of the surrounding tissue, an aggregation of neutrophile leucocytes and eosinophiles, and later necrosis. While necrosis is in progress large fibrous tissue cells together with giant cells are found at the

periphery of the mass; the tissue between the areas is composed of typical granulation tissue, with eosinophiles and proliferation of endothelial cells and fibroblasts.

A few specimens of partially decomposed parasites were obtained from the lesions. Two of these measured 2·25 mm. and 1·3 cm., respectively, in length by 50μ in breadth. In one of these specimens a spinous tip to the tail could be clearly seen. According to RAILLIET this appearance of the tail is diagnostic of the super-family Spiruroidea and it therefore seems most probable that the parasite belongs to the genus Habronema, the adults of which occur in the stomach of the horse.

The authors then further discuss the etiology of the disease and deal with the probability of its being set up by one or other species of Habronema parasitic in the stomach of the horse and, in the case of one species, known to undergo development in the body of the common house fly (RANSOM). Some pre-existing catarrhal condition of the conjunctiva or individual susceptibility may pave the way for infection. The seasonal occurrence of the disease is held to support the view that it is insect transmitted. "Enquiry into the experience of practitioners goes to show that the milder condition is probably common, with symptoms of persistent slight lachrymation without apparent cause, these small bodies being easily overlooked in a casual examination of the eye."

According to the authors the above condition is not to be confused with the early stages of epithelioma of the eye, a lesion of common occurrence.

VAN SACEGHEM (R.). **Cause étiologique et traitement de la dermite granuleuse.** [The Etiology and Treatment of Granular Dermatitis.] —*Bull. Soc. Path. Exot.* 1918. July. Vol. 11. No. 7. pp. 575–578.

Observations already published by the above author on equine granular dermatitis strongly incriminated flies as the vectors of the Habronema larvae which are the causal agents of so-called summer sores [see this *Bulletin*, Vol. 5, No. 4, p. 248]. Further experiments performed by him are stated to confirm absolutely this view and moreover prove that the parasite found in the verminous nodules is an aberrant larva of *H. muscae*. The view formulated by RAILLIET and HENRY [see this *Bulletin*, Vol. 4, No. 3, p. 102] is thus substantiated.

Larvae of the common house fly, *Musca domestica*, bred in the laboratory beyond reach of possible accidental infection were deposited on a freshly deposited mass of dung from a horse known to be infested with *H. muscae*. The flies emanating from these maggots were found to be infested with *H. muscae* in a proportion of 70 per cent. The larvae were numerous in the proboscis and in the body. It was found that the fly could only become infected during its larval stage; the nymph did not become invaded.

Spiroptera larvae die rapidly in fermenting manure owing to the high degree of heat generated, and this furnishes a means for the destruction of verminous larvae. The Habronema larvae isolated from the flies can survive for longer than 12 hours when placed in a liquid medium. When transferred on to the hair or shaved skin of the horse they die off rapidly and never show the slightest tendency to pierce

the skin. On the other hand when deposited on wounded surfaces covered with serous fluid they execute movements and show a marked tendency to become lodged in small crevices.

Horses affected with granular dermatitis often showed conjunctivitis and this was found to be set up by the presence of small verminous nodules located especially on the membrana nictitans. These nodules had the same appearance and disclosed the same parasite as that found in the summer sores.

Habronema larvae withdrawn from the flies were deposited in the inner canthus of the right eye of a horse isolated within an enclosure surrounded by fine mosquito netting. This horse subsequently became affected with conjunctivitis and verminous nodules were found on the membrana nictitans of the right eye. The left eye, which served as a control, did not develop any lesions whereas in the case of the right eye the eyelids became thickened, the conjunctival mucous membrane inflamed, and the membrana nictitans scattered over with small verminous nodules that could be easily enucleated. The infection also set up intense pruritus in the right eye, causing the animal to rub itself continuously.

In another experiment the author made two wounds in the skin of a horse: one of these was protected by netting against flies and the other left uncovered. The horse was placed in a stable in which 20 per cent. of the flies were infected with Habronema larvae. The unprotected wound became the seat of a very intense irritation which caused the horse to bite itself until blood appeared. The wound became transformed into a characteristic summer sore.

The author formulates certain lines of treatment for summer sores based upon knowledge obtained with regard to the habits and life history of the causal organism. Preventive treatment consists in the destruction of *H. muscae* which is found in the stomach of equidae, sometimes in enormous numbers. As a result of numerous post-mortem examinations made by the author upon horses that had succumbed to horse sickness at the Zambi Station, Lower Belgian Congo, where summer sores are very common, it was found that the majority of horses harboured *H. muscae* in their stomachs. Arsenic given periodically in doses of 1–2 grammes per day is considered to be a good remedy against the adult form of *H. muscae*. The destruction of the larval form can be brought about by discarding the use of so-called permanent bedding and taking the precaution to bury fresh dung daily inside a heap of fermenting manure according to the so-called biothermic method formulated by ROUBAUD. Under the action of the heat generated by the dung the Spiroptera larvae as well as the maggots of the flies that may become infested by these larvae are killed off. Wounds on horses should be protected during the dry season against flies by sprinkling over them some astringent powder.

A method of curative treatment regarded as specific by the author consists in careful disinfection of the sore and then in the application of the following powder:—Plaster of Paris 100, alum 20, naphthaline 10, quinine 10 parts, or a sufficient quantity of any other bitter powder. This powder has the property of effectively protecting the sore against flies, being very adhesive, rapidly drying up the sore, and preventing the animal from biting itself owing to the action of the bitter powder contained in it. The powder is said to inhibit further infestation

with larvae with certainty and those already present become encysted and are eliminated without causing any damage. All the sores treated in this way became rapidly cicatrised, care being taken to renew the plaster as long as the slightest breach in continuity of the surface remained.

CHATTON (Edouard). **Microfilaire du chat domestique dans le sud-tunisien.** [Microfilaria of the Domesticated Cat in Southern Tunis.]—*Bull. Soc. Path. Exot.* 1918. July. Vol. 11. No. 7. pp. 571–573. With 1 text-fig.

Microfilariae in the blood of the domesticated cat have apparently only been hitherto reported by MATHIS (1909), who based his report on observations made by GAUDUCHEAU on cats in French Indo-China. The organism described by Chatton was found in 2 out of 26 cats examined; one of these cats came from Médine and the other from Gabès. The microfilaria was observed in the heart blood on post-mortem examination of the animals and was very scanty in the case of the first animal and not by any means numerous in the case of the second (1 in every 30 fields of 400μ in a thick drop of fresh blood). The adult was not discoverable but a thorough search was not undertaken. In the case of the other cats the heart blood was examined in some on post-mortem examination and in others blood from the ear was examined during the day and at night. It was thus not possible to find out whether the organism exhibited a daily periodicity in the peripheral blood.

The morphological characters were briefly as follows:—No sheath, body blunted at its anterior extremity and tapering to a fine point at its posterior extremity. Length very variable even in the same preparation (after fixation with osmic acid vapour)—from 240 to 350μ in length and the breadth seemed to vary inversely to the length, i.e., from 9 to 7μ. This might be due to the varying degree of contraction of the parasite. Moreover, the nuclei appeared to be more closely packed together in the shorter organisms. No cuticular striation. There were four constant clear spots (after staining with Giemsa) viz., (1) a sub-terminal cephalic spot often divided lengthwise in two by a nucleated tract; (2) an obliquely situated linear subtransverse spot 60μ from the anterior extremity in a parasite 320μ long; (3) a laterally situated triangular or V shaped spot 85μ from the anterior extremity in a parasite of the same length; (4) a caudal spot also laterally situated, 50μ from the posterior extremity.

The small worm which often becomes twisted on itself by means of regular curves as in the case of the human nocturnal microfilaria (*F. bancrofti*) has, however, the somewhat crumpled aspect of the diurnal microfilaria (*F. loa*). The few data given with regard to the above parasite does not enable one to differentiate between it and the dog filaria (*F. immitis*), which has been recognised in Tunis by LANGERON.

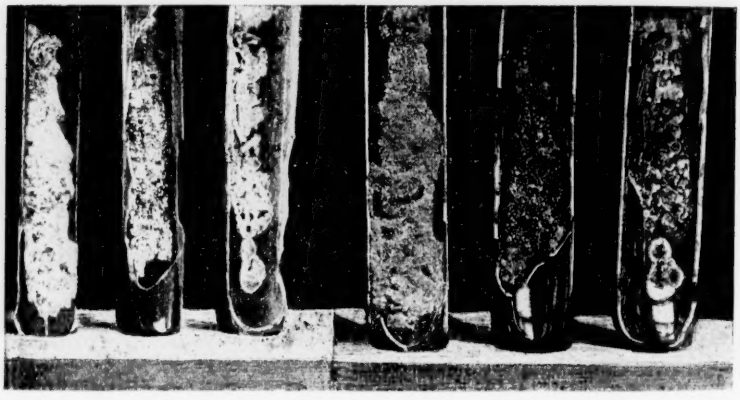
EPIZOOTIC LYMPHANGITIS.

NÈGRE (L.) & BOQUET (A.). **Culture en série et évolution chez le cheval du parasite de la lymphangite épizootique.** [Cultivation in Series and Development in the Horse of the Parasite of Epizootic Lymphangitis.]—*Ann. Inst. Pasteur.* 1918. May. Vol. 32. No. 5. pp. 215–241. With 3 text-figs.

In this paper the authors recapitulate and furnish additional details regarding their researches on the cultivation of the parasite of epizootic lymphangitis [see this *Bulletin*, 1914, Vol. 2, p. 152; 1915, Vol. 3, pp. 71 & 111; 1917, Vol. 5, p. 116; & 1918, Vol. 6, p. 107].

The results obtained by the authors up to the present in their attempts to cultivate the parasite are very briefly summarised as follows:—

Pus containing cryptococci withdrawn aseptically from an unopened abscess and sown on the surface of a medium consisting of agar made up with an infusion of horse dung and then covered with a layer of pulp from the lymph glands also from the horse gives rise to macroscopic colonies which can be transplanted on to media composed of the same material or on to Sabouraud's agar; lymph gland pulp is added in the first few series but then its addition becomes no longer necessary.



1 2. 3. 1. 2. 3.

FIG. 1.*

1. Culture on Sabouraud's agar at 37° C.
2. Culture on horse dung agar at 22° C.
3. Culture on Sabouraud's agar at 22° C.

The 1st group viewed from a slightly inclined direction, the 2nd group viewed directly in front.

The parasite assumes the undoubted characteristics of a fungus on the culture media and with continued sub-cultivation the growth is more easily obtained and is more rapid. After a few passages it can be transplanted on to various kinds of agar media, gelatin, potato, and carrot.

* Figs. 1, 2 & 3 reproduced by permission from the *Annales de l'Institut Pasteur.*

The optimum temperature for the sub-cultures is said to be 37° C. On account of the slow development of the primary cultures this temperature brings about rather too rapid desiccation of the media and a temperature of 25–30° C. is more suitable. At a temperature of 37° C. the colonies on Sabouraud's agar are of a sandy yellow colour and are wrinkled or folded and scattered over with minute areas of a fluffy nature. At lower temperatures the colonies assume a much more marked fluffy appearance. In primary culture the cryptococcus swells up, assumes a rounded appearance, and becomes filled with oily droplets. It then buds giving rise to double-walled mycelial tubes on which are developed the so-called external spores. In subsequent sub-cultures the young colonies are formed of divided or partitioned thin-walled mycelial tubes. In older colonies these filaments disappear after having given rise by budding to the external spores. The latter give rise to double-walled divided mycelial tubes carrying external spores and chlamydospores; they are identical in appearance with the elements which arise from the budding of the rounded forms of the cryptococcus.

The rounded form assumed by the cryptococcus in primary cultures and the external spore thus constitute the origin of the same kind of mycelial formations, which cannot be differentiated by any morphological character. It thus appears that the cryptococcus is the multiplicative form in the animal body of the external spore.

It was found that the cryptococcus could develop in the epidermis of the horse in the shape of mycelial formations identical in appearance with those mentioned above, viz., double-contoured tubes and external spores. It appeared from one observation only, made by the authors and which requires confirmation, that the cryptococcus originates in the epidermis of the horse by budding from the external spore. At the time of budding it only has a thin wall.

In old cultures all the elements forming the mycelial tubes become dislocated and take on a very irregular appearance.

Cultures of the fungus inoculated into the horse by scarification of the epidermis or into the dermis gave rise to buds and abscesses containing cryptococci. After subcutaneous inoculation they set up abscesses containing cryptococci and later these lesions may become generalised with the formation of corded lymphatics and the clinical picture of the natural disease is reproduced.

The cryptococci appear in the lesions in from three to four weeks after inoculation. They are at first free appearing in the form of small thin-walled ovoid elements, later they become double-contoured and then are found for the most part within the leucocytes.

The serum of animals suffering from the disease gives a positive reaction in the fixation of the complement test with the above cultures of the fungus as antigen. Antibodies may be revealed in the blood towards the 20th day after the first appearance of the disease, and they remain for a long time after recovery. After recovery from one attack of epizootic lymphangitis a horse remains refractory to subsequent inoculation with cultures.

It is considered that the fungus cannot be properly classified until a complete study has been made of its sexual method of reproduction.

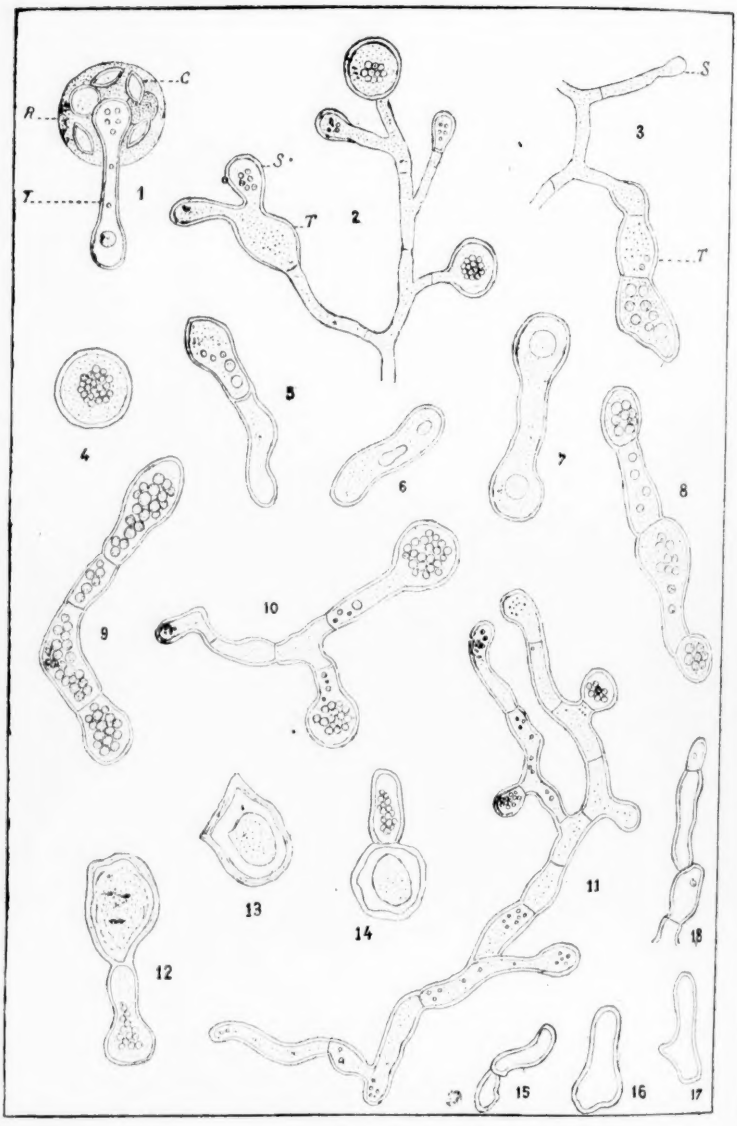


FIG. 2.

1. C, cryptococci within a leucocyte; R, rounded form of the cryptococcus; T, double-contoured mycelial tube arising by budding from a rounded form from a cryptococcus still included within the leucocyte.

2. Thin-walled mycelial tubes in a young colony, giving rise by budding to external spores in different stages of development and to a double-contoured mycelial tube (S), (T) itself carrying a mycelial tube.

3. Thin-walled mycelial tube in a young colony giving rise to a double-contoured tube (T) and first stage of budding of an external spore at the extremity of another branch (S).

4. Free-lying external spore containing droplets of oil.

5, 6, 7, 8, 9, & 10. Double-contoured mycelial formations produced by budding of external spores.

11. Double-contoured mycelial tubes reproducing external spores by budding.

12. Free-lying chlamydospore.

13 and 14. Chlamydospore on mycelial formations.

15, 16, 17 and 18. Disintegrated and distorted mycelial elements in old cultures.

With regard to the authors' experiments on the transmission of the disease by means of cultures it is considered worth while reproducing their data concerning the results obtained by subcutaneous inoculation of the two horses used in their experiments.

FIG. 3.

Reproduction of epizootic lymphangitis experimentally in the horse. Two beaded corded lymphatics on the neck. On the shoulder lesions produced by smearing cultures on the scarified skin.

(1) One third c.c. of an emulsion of the growth obtained from a first sub-culture sown out three months previously and containing sparing cryptococci that had not budded was inoculated subcutaneously on the left side of the neck. For the first three days after the injection a large very painful oedematous swelling developed. This gradually diminished in size and towards the 25th day took the form of a nodule about the size of a pea. This nodule remained very sensitive to pressure and appeared to have become adherent to the underlying tissues. On the 31st day a fragment of this nodule formed

of firm fibrous connective tissue was excised and in the serous fluid obtained from it small elements about the size of cryptococci, some of which were without a double-contour and others with a characteristic double-contour, were seen under the microscope. Towards the 50th day the lesion assumed a secondary phase characterised by increase in size of the nodule which reached the dimensions of a large walnut and by the appearance of oedematous swellings, viz., a swelling surrounding the lesion and swellings some distance away on the level of the throat and towards the front of the shoulder. On the 60th day these oedematous swellings disappeared, the nodule increased in size, fluctuated and burst, discharging pus containing cryptococci. A small firm corded swelling appeared as an outgrowth from the nodule; this small cord disappeared at the end of two days and then reappeared on the 70th day. On this date two oblique corded lymphatics were seen to emanate from the suppurating bud and become directed towards the jugular furrow. The lower cord was about the thickness of a large pencil and presented along its course a number of buds each about the size of a sixpence. The upper cord was smaller in size. At their lower ends these cords ran closer together. They reached in length about two thirds the length of the neck. The lower cord presented 11 closed buds, the upper cord 7. On the 73rd day the upper cord disappeared and its remains were indicated only by two small buds. Only a single beaded lymphatic thus remained. At the end of 4½ months the buds suppurated. Recovery took place in 7 months.

(2) The horse experimented upon was inoculated with an 8th subculture from a strain isolated 11 months previously. One and a half c.c. of an emulsion of a three weeks' old culture was inoculated underneath the skin at the level of the right and left shoulders. A large widespread very painful oedematous swelling developed during the first 4 days after the inoculation. On the 5th day the oedematous swelling disappeared leaving firm nodules about the size of an almond. The nodules diminished in size up to the end of the third week. They then began to increase in size and at the end of four weeks each was about as big as a large hen's egg. A few days afterwards firm filiform cords appeared starting from the nodules and descended round in front of the fore arm down to about its middle. After about two months the nodule on the left shoulder began to suppurate and its contents gradually became discharged. The nodule on the right remained much longer in the form of a large indurated mass which finally became softened and discharged a pus containing cryptococci.

[These experiments on the transmission of the disease by rich cultures are not altogether convincing inasmuch as the disease set up was mild in character compared with that observed in most cases of the natural disease and apparently disappeared spontaneously. Also, it might occur to one that in the first experiment especially the lesions could perhaps have been set up by minute quantities of the original cryptococci which had remained unchanged on the media after sowing out from the pus. The organisms are well known to retain their vitality for a considerable time.—Ed.]

Boquet (A.), Nègre (L.) & Roig (G.). i. **Premiers essais de vaccination préventive contre la lymphangite épizootique.** [Experiments in Preventive Vaccination against Epizootic Lymphangitis.]—*Bull. Soc. Path. Exot.* 1918. July. Vol. 11. No. 7. pp. 551–553.

——, —— & ——. ii. **Mycothérapie de la lymphangite épizootique.** [Mycotherapy of Epizootic Lymphangitis.]—*Ibid.* pp. 609–616.

Hitherto, owing to the fact that artificial cultures of the organism of epizootic lymphangitis have not been obtainable, the treatment of this disease has only been undertaken with chemical agents, e.g., potassium iodide (Teppaz), arsenobenzol (Bridré, Nègre & Trouette), with the pus containing the cryptococcus from affected animals (Belin, Velu), or with biological products, e.g., yeast extract (M. Nicolle, Fayet & Truche). Recently Bridré [see this *Bulletin*, 1918, Vol. 6, No. 1, p. 17] has shown that good results may be obtained by the use of aseptic pus and these cast doubt on the action of the cryptococcus in the treatment devised by Belin and by Velu.

The material used by the authors for vaccination was prepared as follows:—

The colonies of cryptococci about two months old are lifted from the Sabouraud's agar medium by means of a spatula, crushed up finely in a mortar and then emulsified in normal saline solution in the proportion of 1 tube of culture to 30 c.c. of liquid. About 20 centigrammes of dry culture are obtainable from a medium sized test tube. The superficial parts of the colonies only are utilised, the deeper parts remaining adherent to the agar. This emulsion is distributed in ampoules which are sealed and heated for 1 hour at 62° to 64° C. Heating at this temperature is sufficient to eliminate the pathogenicity of the fungus. The vaccine is injected subcutaneously in the region of the neck commencing with a dose of 2 c.c. and increasing this dose by 1 c.c. with each successive injection but in no case exceeding 5 c.c. The injections are performed at weekly intervals. The horses injected did not receive any other treatment or any surgical operation and the abscesses were left untouched. Fourteen horses were treated by means of these heated cultures. The results in four of these cases could not be followed up on account of difficulties in keeping them under observation, but the data obtainable from the treatment of these four preliminary cases enabled the authors to fix upon a suitable method for administering the vaccine. These cases are described very briefly in the first paper. In the case of the remaining 10 horses affected with more or less long standing and severe forms of the disease the authors report at greater length upon their progress under treatment. They divide these cases into two categories, viz., (1) those with cutaneous lesions, buds and abscesses but without apparent corded lymphatics, and (2) those with corded lymphatics. Two of these animals died from secondary infections in the course of the treatment. The other 8 animals recovered after intervals of from 1 to 3½ months from the commencement of the treatment and none of these animals suffered from a relapse.

With regard to the effects of the inoculations upon the treated animal one finds a fairly large, very painful, tender swelling about the size

of the palm of the hand at the seat of injection for 24 hours after the inoculation. The temperature rises about 1° C. on the following day and remains above normal for 2 or 3 days. The swelling becomes absorbed in 3 or 4 days but the seat of injection remains painful for several days afterwards. After the 3rd and sometimes the 4th injection there forms at the seat of inoculation an abscess which may become absorbed or open and discharge a sterile pus. After each of the first injections the lesions of the disease become distinctly exacerbated: the buds and abscesses suppurate more freely and this stage may cover 5 or 6 days. It corresponds, as VELU has shown, to a negative phase and may appear to last so long as the product injected has not been completely absorbed. If the vaccine is injected again during this first phase bad results are always obtained, and successive injections given at less than 6 or 7 days interval cause the disease to assume a very acute form. After the 3rd or 4th injections the continued treatment does not appear to exercise much apparent effect upon the disease. All the lesions continue to suppurate and one might be led to abandon the treatment as inefficacious, but suddenly the course of the disease changes, the lesions become dried up and then cicatrise rapidly, the swelling around the corded lymphatics disappear and the corded lymphatics themselves gradually diminish in size, the deeply situated glands regain their normal size, and recovery then takes place. Recovery is most rapid in the case of lesions which suppurate most readily; it is much slower in the case of the corded lymphatics and in the case of these lesions surgical intervention, as VELU has shown, would undoubtedly hasten recovery. In the former cases recovery was obtained in from 1 to 2 months, i.e., after 4 to 8 injections, but in the cases with corded lymphatics recovery took from 3 to $3\frac{1}{2}$ months, i.e., after about 9 injections.

CARPANO (Matteo). **Le associazioni batteriche nelle infezioni da *Cryptococcus farciminosus* (Rivolta 1873).** [Bacteria associated with the Cryptococci in Epizootic Lymphangitis.]—*Ann. d'Igiene.* 1918. June 30. Vol. 28. No. 6. pp. 273–279.

In a small outbreak of epizootic lymphangitis occurring in the district around Rome the following results were obtained on examination of pus obtained from the lesions:—Cryptococci alone 5 cases, cryptococci mixed with *Staphylococcus aureus* and *albus* 6 cases, with a non-specific pyogenic organism 1 case, and with *Staphylococcus pyogenes*, a streptococcus, *B. subtilis*, *Proteus vulgaris*, and various species of Hyphomycetes, 1 case.

A further examination of material obtained from early and closed deep-seated lesions taken so as to avoid risk of outside contamination was made. Out of 41 cases found to contain cryptococci on microscopic examination these organisms were found associated with streptococci and staphylococci in 15 cases, with streptococci alone in 10 cases, and with staphylococci alone in 2 cases.

A bacteriological study of the associated micro-organisms was made. The streptococci were found to be indistinguishable from that of strangles, while the staphylococci represented nearly all varieties of *Staphylococcus pyogenes*.

BACTERIAL DISEASE.

Mason (F. E.). **Tuberculosis in the Camel.**—*Jl. Comp. Path. & Therap.* 1918. June. Vol. 31. Pt. 2. pp. 100–102.

The author has dealt with the above subject in a previous communication [see this *Bulletin*, 1917, Vol. 5, No. 2, pp. 117–118]. In the present article he places on record what is believed to be the first authentic case of congenital tuberculosis in the camel. The tuberculous lesions were found in the liver of an eight months old foetus; this organ contained numerous nodules varying in size from a pea to a haricot bean and its lymphatic glands were enlarged to the size of a walnut and caseous. No other lesions were found in the body. Numerous acid-fast bacilli were found in the lesions and after cultural examination and guinea-pig inoculation these were concluded to be of the bovine type.

The dam of this foetus was tested with ordinary tuberculin (4 c.c. subcutaneously) and a distinct temperature reaction was obtained. The animal was then slaughtered and advanced lesions of tuberculosis were found in the visceral organs.

In former articles the author has drawn attention to the small number of cases of tuberculosis recorded in camels outside Egypt. The number of recorded cases does not appear to exceed four. The author now records an old-standing case of pulmonary tuberculosis in a recently imported Algerian camel. The nature of the lesions indicated that this animal had undoubtedly become infected prior to the date of importation.

DISEASES DUE TO FILTERABLE VIRUSES.

Remlinger (P.). i. **Diffusion du virus rabique dans la glycérine.** [Diffusion of Rabies Virus in Glycerine.]—*C. R. Soc. Biol.* 1918. Jan. 12. Vol. 81. No. 1. pp. 20–21.

——. ii. **Passage "in vitro" du virus rabique dans des cerveaux et dans des organes.** [The Diffusion *in vitro* of Rabies Virus in Brains and Organs.]—*Ibid.* Jan. 26. No. 2. pp. 55–57.

——. iii. **Sur un lapin naturellement réfractaire à la rage.** [A Rabbit Naturally Resistent to Rabies.]—*Ibid.* Feb. 23. No. 4. pp. 162–164.

——. iv. **Imperméabilité du tube digestif des animaux jeunes au virus rabique.** [Impermeability of the Digestive Tracts of Young Animals to the Rabies Virus.]—*Ibid.* Mar. 23. No. 6. pp. 277–278.

——. v. **La rage conceptionnelle est-elle possible?** [Is it Possible to Contract Rabies at the Time of Conception?]—*Ibid.* Apr. 27. No. 8. pp. 418–419.

——. vi. **Le virus rabique se généralise-t-il** *post mortem*? [Does the Rabies Virus become Generalised Post-mortem?]—*Ibid.* June 8. No. 11. pp. 564–566.

i. Although the preservative properties of glycerine with regard to rabies virus are made constant use of in anti-rabic institutes no

attention appears to have been paid to the question as to whether the virus passes into the glycerine itself. A number of brains of animals that had succumbed to rabies were immersed at various temperatures (0° C., 12–15° C., 37° C.) in glycerine kept in a vessel in the dark. In from 6–10 days the glycerine was filtered through muslin or filter paper and injected intramuscularly into guinea-pigs and rabbits. Six out of 13 animals were subsequently definitely proved to have succumbed to rabies. The infectivity of the glycerine in these cases would appear to be due to a diffusion of the virus and as there could be no question of its growth the virus thus differs considerably from a number of visible micro-organisms such as the anthrax bacillus and the tubercle bacillus, which show no tendency to spread from organs such as spleen into the surrounding glycerine.

ii. A number of brains of rabbits or guinea-pigs dead of rabies were washed in normal saline solution and immersed in a vessel containing about 50 c.c. of sterile glycerine. The brain of a healthy rabbit was suspended in this liquid and the whole kept in the dark at room temperature. Pieces of the healthy brain taken at intervals from the 4th to the 12th day were found to induce rabies in about one third of the animals subsequently inoculated.

Positive results were likewise obtained when the brains of animals immune to rabies such as the fowl or land turtle were suspended in the glycerine. Similarly when the liver or kidney was used instead of the brain positive results were obtained in a certain number of cases. The author concludes from these results indicating the diffusibility of the virus that the Negri bodies of rabid brains are in all probability devoid of pathogenic action; they are very likely products formed in the defence of the body against the causal organism or toxin.

iii. Inoculation of rabies virus sub-durally into the rabbit constitutes one of the most severe tests to which a laboratory animal can be subjected. With precise regularity the animal shows the first symptoms on the 6th or 7th day and succumbs from 3 to 5 days later. Out of several thousand inoculations thus performed by the author at Constantinople one rabbit only was found resistent. The operation was repeated three times on this rabbit without success. Viala observed one similar case in 1909 at the Pasteur Institute, Paris, where several thousand such inoculations have been performed. In this paper the author places on record the case of a rabbit which showed exactly the same history as the above at Tangier. The natural immunity in the case of these rabbits is of somewhat extraordinary interest inasmuch as it is found extremely difficult to confer protection against "street" rabies on the healthy rabbit in the laboratory.

iv. Ten adult guinea-pigs were fed with emulsion of brain substance taken from animals that had succumbed to rabies; three subsequently died from rabies. One of the symptoms was marked sniffing and thus it was suspected that infection might have taken place via the nostrils. In a second series of experiments 30 young guinea-pigs less than 25 hours old received a thick emulsion in milk of fixed virus that had been adapted by numerous passages to the body of the guinea-pig; great care was taken to avoid contamination of the nasal mucous membrane. The result was absolutely negative. Twenty young

rabbits from 8 to 12 days old were made to ingest an emulsion of fixed virus in a similar manner. No deaths occurred.

The mucous membrane of the digestive tract of the rabbit and guinea-pig thus appears to offer a powerful resistance to penetration by the rabies virus inasmuch as young guinea-pigs even a few hours old could not be infected. This resistance is very remarkable inasmuch as closely related rodents, namely the Muridae, can be infected very easily, even as adults, by way of their digestive tract.

v. KONRADI and others have recently proved beyond doubt the hereditary transmission of rabies in certain cases and the question arises whether the virus can be transmitted at the time of conception. In order to elucidate this question the author performed the following experiments on the guinea-pig, in which animal genital excitability is as a rule most marked, especially when infected with "street" virus. Transmission at conception would require the presence of the virus in the spermatozoon or in the ovum and thus the experiments were carried out with the contents of the seminal vesicles of the testicles and the ovaries of rabid guinea-pigs. All the experiments were carried out with "street" virus maintained by transmission through a series of guinea-pigs.

The contents of the seminal vesicles of 15 guinea-pigs that had died from rabies were emulsified in normal saline solution and in each case inoculated under the dura mater of a rabbit and of a guinea-pig. In addition the inoculated guinea-pig was injected into the muscles of the neck with the whole of the emulsion that had not been used up in the sub-dural injections. None of the inoculated animals developed rabies.

The testicles of 6 rabid guinea-pigs were macerated and the whole of the emulsion inoculated under the dura mater and into the neck muscles of 12 guinea-pigs. None of these developed rabies.

The ovaries of 6 guinea-pigs that had died after inoculation with "street" virus were carefully triturated in salt solution and inoculated sub-durally and into the neck muscles of 6 rabbits. None of these developed rabies.

Finally, the bodies of 48 guinea-pigs that had died of rabies were kept for from 24 to 48 hours at laboratory temperature before the ovaries (24 guinea-pigs), the testicles (12 guinea-pigs), and the contents of the seminal vesicles (12 guinea-pigs) were excised and used for inoculation. These were inoculated exclusively into the neck muscles of the rabbit or guinea-pig, in order to eliminate the setting up of meningitis due to the inoculation of post-mortem invaders. In order to make up for the decreased amount of severity following this method of inoculation the author inoculated double the quantities used in the preceding experiments into each animal. None of the animals inoculated (12 rabbits, 24 guinea-pigs) developed rabies.

The absence of the virus in the semen has already been demonstrated by various authors. BLASI and RUSSO TRAVALI are the only workers who claim positive results. No work appears to have been hitherto performed on the ovary. All the animals inoculated by Remlinger were kept under observation for 16 months subsequent to inoculation. He thus concludes that rabies is not transmitted by conception and

that all cases of hereditary rabies are connected with placental infection.

vi. The author recalls the results of the last-described experiment in which the ovaries, testicles and seminal fluid of guinea-pigs were used for inoculation in from 24 to 48 hours after death; from these he concludes that the onset of putrefaction does not bring about the presence of the rabies virus in an organ where it is not found during life or during the first few hours after death.

The question next arises whether the virus may gain access after death into an organ in which it is not constantly present during life. The spleens of 12 guinea-pigs killed a few hours before natural death were emulsified and in the case of the emulsion from each spleen as much as possible was inoculated sub-durally and the remainder into the neck muscles of a healthy guinea-pig. Three of the inoculated guinea-pigs developed rabies while 9 remained healthy. Twelve other guinea-pigs were inoculated similarly with spleens taken in from 1 to 12 hours after natural death; 3 out of 12 likewise of the inoculated animals developed rabies. In a third series of experiments 12 guinea-pigs dead of "street" rabies were left from 24 to 48 hours at laboratory temperature and emulsions of their spleens then inoculated into the neck muscles of healthy guinea-pigs; 1 animal only developed rabies.

Inasmuch as the greater number of negative results in the last experiments might be due to the diminished severity in the method of inoculation the author inoculated into the neck muscles of each guinea-pig from 2 to 3 spleens in order to counterbalance this factor. Also in this series of experiments the carcases were left unopened for from 2 to 3 days. Out of 6 guinea-pigs inoculated 1 only developed rabies. It would thus appear that instead of favouring the multiplication or diffusion of the virus the onset of putrefaction caused it to be less readily discoverable. This fact, however, is most probably due to the lessened chances of infection on account of the method employed of inoculating intramuscularly.

In a final series of experiments this cause of error was eliminated. The suprarenal capsules of 16 rabid guinea-pigs killed just before death were macerated, emulsified, and inoculated into the neck muscles of 16 guinea-pigs; 7 (44 per cent.) developed rabies; the others survived. Another series of 16 guinea-pigs was similarly inoculated with the suprarenal capsules of 16 guinea-pigs dead of rabies and kept for from 24 to 48 hours at laboratory temperature before post-mortem examination was performed; 11 (68 per cent.) developed rabies, the others survived.

It appears from the above data that post-mortem generalisation of rabies is rare and inconstant. Moreover, the experiments that have hitherto been performed in order to ascertain the distribution of the virus in various organs are not apparently vitiated with serious error on account of the fact that account had not been taken of the possibility of generalisation.

The virus appeared to become less readily diffused in the animal body than it does *in vitro* in normal saline solution, Locke's fluid, glycerine, and other liquids.

LANFRANCHI (A.) & LENZI (F.). **Sur le passage du virus rabique de la mère au foetus.** [Passage of the Rabies Virus from Mother to Foetus.]—*C. R. Soc. Biol.* 1918. Apr. 27. Vol. 81. No. 8. pp. 396–398.

A pure bred wolfhound bitch, 10 months old, was brought under the authors' observation suffering from dumb rabies. This animal possessed a history of having been in contact with a dog suffering from rabies and though it showed no obvious signs of having been bitten it was quarantined for 6 months. It was then returned to its owner, and lined by a great dane. The bitch died the day after it had been brought to the author's clinic and seven full-grown foetuses were withdrawn post-mortem. Examination as to the presence of Negri bodies in the hippocampus gave positive results in the case of the mother but negative in the case of the foetuses.

The spinal cords of the bitch and the seven pups were withdrawn with sterile precautions and inoculated into rabbits either sub-durally, into the anterior chamber of the eye, or intramuscularly. All the rabbits inoculated succumbed with characteristic symptoms of rabies on the 12th day. The rabbits were submitted to careful clinical observation in order to make certain that they were really suffering from a rabies infection. The rise in temperature shown to occur by BABES at the commencement of the disease was looked for in particular and also the loss in weight to be noted in rabbits dead of the infection was established up to a third series of passages.

In the above case there is thus no doubt that the rabies virus traversed the placental filter and reached the nervous system of the foetuses from the mother.

Contrary to the statements of LOIR and KONRADI no attenuation of the virus was noticed after it had passed through the placental filter; there appeared to be no differences especially with regard to the duration of the disease and its clinical course. According to KONRADI the period of incubation in guinea-pigs inoculated sub-durally with brain material from foetuses may be extremely long, even up to 725 days in one of his cases. It is thus probable that the negative results claimed by some authors, such as REPETTO, were due to the fact that the experimental animals were not kept long enough under observation.

KOYANO (Tadayasu). **Beiträge zu den experimentellen Studien über die Lokalisation des Wutvirus.** [Experimental Studies on the Distribution of Rabies Virus.]—*Mitteil. a. d. Med. Fak. d. Kais. Univ. zu Tokyo.* 1917. July 9. Vol. 18. No. 1. pp. 91–101.

Although the virus of rabies resides principally in the central nervous system recent work of authors shows that it varies greatly in quantity in different parts of the brain and spinal cord and the nerve trunks; with regard to its presence in the cerebro-spinal fluid and other organs of the body opinions are somewhat sharply divided.

An interesting review of this subject is given by the author. In his own experiments a number of rabbits were injected with "fixed" virus and after their death various parts of the central nervous system and other organs inoculated into healthy rabbits. He concludes that the secretory organs, especially the salivary glands, submaxillary,

sublinqual, and parotid, as well as the haematopoietic organs such as the spleen and lymphatic glands, are not invaded in the case of infection with the " fixed " virus or, at any rate, the presence of virus cannot be demonstrated in them by animal experiment. The secretory organ found inside the skull, that is to say, the anterior lobe of the pituitary body, on the other hand, is certainly virulent. The posterior lobe of this gland was also found to be constantly virulent, whilst the cerebro-spinal fluid on the other hand, taken from the central canal of the spinal cord and from the sub-dural space, was avirulent.

SCHERN (Kurt) & MAVRIDES (Nikolaik). **Ueber Rinderpest. (Erste Mitteilung.) Spontane klinische Heilungen bei Rinderpest.** [Spontaneous Clinical Recovery in Rinderpest.] —*Ztschr. f. Infektionskr. . . . d. Haustiere.* 1918. June 3. Vol. 19. No. 3. pp. 193–196. With 3 charts comprising 50 figs.

In the fourth stomach of apparently healthy cattle killed at an abattoir in Asia Minor MROWKA observed lesions very closely resembling those of rinderpest. The investigations carried out by the authors were made in order to determine whether these were in reality spontaneously healed rinderpest lesions. Their observations were made on so-called virus cattle used in the anti-rinderpest serum institute at Pendik.

The majority of these animals became so severely affected after artificial infection that they were bled for virulent blood when the symptoms were at their height. In many cases, however, the animals manifested after infection only slight symptoms and subsequently became recovered in the clinical sense. It has recently been customary to slaughter all these apparently recovered animals and thus opportunities were afforded for a minute examination of the various organs. During the years 1915–1917 1,734 animals were infected with virus and of these 543, or 31·31 per cent. recovered. These comprised almost exclusively Anatolian cattle, which are much more resistant to rinderpest infection than European breeds. In natural outbreaks it is estimated that from 45–50 per cent. of these native cattle spontaneously recover.

The authors carefully depict on their charts the results concerning 50 of these recovered animals—including date of infection, clinical symptoms, date of slaughter, and post-mortem changes when present. From these results it is noticeable that the great majority of the clinically recovered animals still showed evidence of rinderpest on post-mortem examination. The results in the case of three of these animals may be given briefly in order to demonstrate this.

One animal after subcutaneous infection showed clinical symptoms lasting 4 days. Forty-one days later it showed typical lesions in the fourth stomach consisting in ecchymoses of the mucous membrane of the pyloric region. The second animal manifested clinical symptoms ending 13 days after the artificial infection. On slaughter 88 days later it showed typical lesions in the heart and fourth stomach (very numerous widespread protruding haemorrhages under the endocardium of the left heart; recently healed congested scars on the pyloric mucous membrane; the fourth stomach was used for artificial infection). The third animal showed no apparent clinical symptoms and no rise

in temperature after artificial infection. Nevertheless on slaughter 20 days after infection it showed a few congested healing patches on the pyloric mucous membrane.

In cases where the rinderpest infection was complicated by the piroplasmosis due to *P. bigeminum* or *Theileria parva* the process of healing in the lesions involving the mucous membrane of the fourth stomach was considerably retarded. From their results the authors consider that in rinderpest infected countries lesions of the fourth stomach and of the heart particularly are to be looked for as evidence of recovery from rinderpest. In infected animals lesions may be found even in cases that showed no clinical evidence of the disease during life.

ALDIGÉ (E.). **Notice sur la péripneumonie contagieuse des bovidés en Afrique occidentale française.** [Contagious Bovine Pleuro-Pneumonia in French West Africa.]—Imprimerie du Gouvernement général, Gorée. 1917. Abstracted in *Rev. Gén. Méd. Vét.* 1918. Apr. 15—May 15. Vol. 27. Nos. 316–317. pp. 152–153.

"The above disease affects cattle and buffaloes. A few species of wild cattle such as yak and bison are susceptible while all other species of animals are resistent under natural conditions of their life.

"The Peuhls of Guinea term the disease *Dioppé*, meaning lung, and hence, disease of the lung. It seems that pleuro-pneumonia has been in existence for a long period in French West Africa. It persists in an enzootic form in Central Africa and Mauritania, whence from time to time it spreads and produces severe outbreaks in the breeding districts of French West Africa.

"The disease has been recorded since 1912 in Soudan, Dahomey, the Ivory Coast, Guinea, and Senegal; it has appeared in a very severe form and caused considerable losses. In this territory pleuro-pneumonia presents the same clinical and post-mortem appearance as it does elsewhere.

"Different breeds appear to vary in susceptibility. The breeds found along the Dahomey coast 'seem to be refractory to pleuro-pneumonia' (PECAUD). In French West Africa the n'dama breed of Guinea is more sensitive then zebus and cross breeds. The increase in breeding operations in the country and long journeys favour the dissemination of the disease. In the event of great outbreaks centres of infection appear along the traffic routes.

"The author studied the effects of inoculating pleuro-pneumonia lymph into young cattle; the injection of 2 c.c. just behind the shoulder gave varying results from a very extensive oedematous swelling down to no apparent reaction. Older animals seem to react more frequently and exhibit more severe reactions.

"Preventive inoculation has been practised by the Moors for several centuries, and it is of common use among certain peoples and completely unknown among others. The natives usually insert under the skin of the forehead a small piece of lung that has been allowed to macerate for several days in water or buried in earth or sand. Calves are inoculated in the ear, caudal inoculation is not practised. Aldigé recommends the inoculation of lymph diluted in a watery solution of carbolic acid, glycerine and citric acid. The virus is injected into the tail by inoculation into the superficial structures. The subsequent history of the animals and the complications that occur are very much the same as those observed in the case of European cattle. Sometimes, however, swellings develop at a considerable distance from the point of inoculation.

"The author does not believe that the method of stamping out is applicable in combating pleuro-pneumonia in West Africa, inasmuch as the centres of disease are innumerable and the animals are moved about so frequently. The application of any other means likely to produce good results is difficult. 'A rigorous prophylaxis of the infection [he writes] is at the present time impossible in French West Africa.'"

VAN SACEGHEM (René). **La peste du cheval ou horse sickness au Congo belge.** [Horse Sickness in the Belgian Congo.]—*Bull. Soc. Path. Exot.* 1918. May. Vol. 11. No. 5. pp. 423–432.

Horse sickness has only been observed in the Belgian Congo in the Province of Katanga where it has appeared in the form of an epizootic in the stud of the Zambi Agricultural Station, Lower Belgian Congo. In order to confirm the diagnosis the author injected into a healthy horse 2 c.c. of oedematous fluid collected from the intermuscular spaces of a horse that had just died of the disease. Four days after inoculation the horse showed a marked foetid diarrhoea and towards the end of the 5th day the temperature began to rise slowly. On the 6th day distinct symptoms became observable, temperature 40·4° C., conjunctival mucous membrane congested and membrana nictitans covered with large petechiae; lachrymation, upstanding coat, and depression were also noticed, but the appetite was maintained. Also numerous wheezing noises were heard, buccal mucous membrane was congested, tongue thickened, salivation increased, respiration accelerated, pulse 90 and strong. On the 7th day these symptoms remained, temperature 40·7° C. and the pulse became thread-like; appetite remained. On the 8th day the appetite was lost, the temperature fell from 39° to 36·5° C. and the horse died on the morning of the 9th day. It is stated that the lesions usually seen in horse sickness were all discoverable post-mortem.

With regard to the origin of the outbreak among the horses the following somewhat striking observations were made by the author. Horse breeding had been carried on very successfully at Zambi since 1908 and no cases of horse sickness or other serious disease had been observed among the horses. In May 1917 a flock of sheep was imported from Angola and these were allowed to graze for several days in the pastures occupied by the horses and cattle of the station. These sheep were affected with several parasitic diseases and then a large mortality occurred among the flock. The sheep died after having shown fever, and also spasms and stiffness of the limbs were constant symptoms. On post-mortem examination the lungs were covered with large petechiae; the pericardial sac was greatly distended and surrounded at its base with a gelatinous exudate. The pericardial fluid was very abundant (more than 100 c.c.), white and rapidly coagulated. Gelatinous amber-coloured masses were found on the peritoneum and the omentum was covered with an exudate of a gelatinous aspect and consistency. The liver was hypertrophied.

A few weeks after the arrival of these sheep at Zambi horse sickness made its appearance and subsequently caused very serious losses in the stud.

The symptoms and lesions observed in the case of the sheep were identical with those of the disease known as "heartwater" and thus the author was led to believe that "heartwater" and horse sickness might be two diseases possessing a common origin, as previously suggested by EDINGTON and Morton COUTTS. In order to obtain experimental evidence in support of this view the author injected subcutaneously a Java horse born at Zambi with 20 c.c. of pericardial fluid from a sheep showing symptoms of "heartwater" and slaughtered *in extremis*. The horse died 9 days after the injection of the fluid

with all the symptoms and lesions of horse sickness. The author thus feels justified in stating that horse sickness was introduced into Zambi by a flock of sheep coming direct from Angola. These sheep were said to have come from a district where "everything died."

The question arises whether the lesions of "heartwater" observed in the Congo in the above sheep were identical with those found in the disease long known to affect cattle, goats, and sheep in South Africa. The author himself was unable to reproduce the disease by inoculating an ox of the Dahomey breed and a Breton heifer with the blood of Angola sheep affected with "heartwater," but, on the other hand, the susceptibility of these breeds for "heartwater," has not been studied. In the case of native sheep, which are naturally resistent towards "heartwater" the injection of blood produced marked febrile reactions. A native goat showed a temperature reaction of 42° C. subsequent to inoculation.

Theiler and Stockman, however, showed that goats vaccinated against horse sickness were still susceptible to "heartwater" infection and thus concluded that the two diseases were not caused by the same virus. Van Saceghem's experiments showed that native sheep exhibited a febrile reaction after having been injected with the virus of horse sickness, and his experiments were thus in concordance with those of Edington.

It has not been shown that the virus of horse sickness can give rise to "heartwater" experimentally.

Theiler showed that the virus of horse sickness could be transmitted by inoculating goats and dogs in series.

Experiments performed by the author at Zambi on the transmission of horse sickness to cattle gave negative results. On the other hand a goat inoculated with defibrinated blood from a horse affected with horse sickness succumbed 15 days after the injection. A sheep inoculated with citrated blood from a lamb dead of the disease causing serious losses among the Angola sheep died a month afterwards; a goat inoculated with defibrinated blood from this sheep died 16 days afterwards with the same symptoms as the goat inoculated with horse sickness blood.

The tick *Amblyomma hebraeum* is recognised as the transmitting agent of "heartwater" in South Africa. This tick does not exist at Zambi but *A. variegatum* and *A. splendidum* are to be found there. Sheep dead of "heartwater" and horses dead of horse sickness were infested especially with *Rhipicephalus appendiculatus* and *R. evertsi* var. *albigeniculatus*. The outbreak of horse sickness in Zambi spread, however, among horses from which ticks had been carefully got rid of, and in a district where there were no ticks. Ticks, however, have been proved to harbour the virus for a very considerable time in their bodies. It has, however, been shown that mosquitoes and other biting flies are capable of transmitting the disease. The author observed that horse sickness propagated especially within a limited area and particularly among horses belonging to the same lot. Police horses traversed the whole region during the course of the outbreak and the only precaution taken was to keep them at a distance from the infected kraals. None of these horses became infected. For this reason the author believes that the principal transmitting agent at Zambi is a small biting fly of the genus *Culicoides* Latr. closely

related to *C. neavei* Aust. These never separate themselves from the groups of horses and are difficult to find during the day. They are only seen flying from animal to animal in the very early morning, and often make their way into the conchal cartilage of the ear. During the outbreak there were also to be found numerous flies of the species *Tabanus pluto.*

A few small experiments in the treatment and control of the disease were undertaken.

The following are the author's conclusions :—

(1) "Heartwater" of sheep gave rise to horse sickness in the horse but was not transmissible to cattle.

(2) The virus of horse sickness produces febrile reactions in goats and sheep.

(3) The virus of horse sickness and of "heartwater" should be considered as two varieties of the same virus.

(4) Horse sickness is spread at Zambi especially by biting flies Culicoides and Tabanus.

(5) Horses of the Bayar, Cayor, and Senegal breeds are very resistant towards horse sickness. On the other hand horses of the Ardennes, Java (Sandal Wood), and Russian breeds show little resistance.

(6) Large doses of camphorated oil injected subcutaneously bring about good results in the treatment of horse sickness.

(7) It seems that one can immunise horses by progressive injections of virulent serum mixed with an equal volume of glycerine and allowed to come in contact with ¼ of its volume of sulphuric ether for 12 hours.

MISCELLANEOUS.

DODD (Sydney). **Studies in Black Disease. A Braxy-Like Disease of Sheep.**—*Jl. Comp. Path. & Therap.* 1918. Mar. 30. Vol. 31. Pt. I. pp. 1–35.

This article is of great general interest inasmuch as it throws light on the role of the anaerobic organisms incriminated by various investigators as the cause of braxy-like diseases in sheep in various parts of the world. The disease known as "black disease" studied by Dodd appears to have caused considerable mortality among sheep in the Southern Highlands of New South Wales for the last 50 years. The condition owes its name probably to the fact that the under-surface of the skin assumes a dark colour soon after removal from the body. A condition which is very similar if not identical occurs in Victoria and was investigated by GILRUTH (1910–1911) who assigned as the cause of the disease a bacillus (Gilruth's bacillus). The clinical features and lesions of the disease also resemble those of a braxy-like disease of sheep in Tasmania and of the disease known as braxy or bradsot in Europe.

The so-called black disease is distinctly enzootic in character; a high mortality may occur among sheep kept in certain paddocks whereas in closely adjacent ones no losses occur. The disease usually makes its appearance about February (late summer) and lasts until about May (early winter). Animals may be attacked at any age and those affected are invariably in good condition; sex does not appear to play any part. The mortality varies considerably every year; in some flocks it may rise from 15 to 30 per cent. per annum.

Unless sheep are watched closely all day no symptoms are observed; the animal is simply found dead. If a flock is very carefully watched cases are found to show slight signs of illness prior to death. These do not generally last more than a few hours and a sick animal is found to become separated from the rest of the flock, stagger, and then lie down quietly; the temperature varies from 104° to 107° F.; there is marked injection of the visible mucous membranes, the respirations are shallow and the pulse weak or almost imperceptible.

The post-mortem examination shows changes such as would be brought about by a severe toxaemia and the nature of the lesions is rapidly masked by post-mortem decomposition. In animals examined immediately after death or killed when on the point of death there is usually observed congestion of the subcutaneous vessels, sometimes a considerable excess of clear straw-coloured fluid in the serous sacs; the liver, spleen, kidneys, and lymphatic glands are congested in varying degrees, the mucous membrane of the abomasum in a few cases shows congestion, while that of the small intestine appears to show invariably intense congestion over a considerable extent of its surface.

In 1914 the author's investigations with regard to the etiology of the disease were all performed with material obtained from sheep recently found dead. It was found that subcutaneous inoculation into susceptible sheep of heart blood and peritoneal fluid from sheep found dead resulted in death. The principal post-mortem lesions produced bore more resemblance to those of malignant oedema than to those of black disease. Feeding experiments with minced up abomasum, intestines, liver, kidneys, etc., were negative. Two main types of bacilli, both anaerobes, were isolated from the sheep found dead, viz., (1) braxy type, (2) malignant oedema type. Experimental inoculation into sheep of the bacillus of the braxy type which was isolated from the sheep found dead of black disease had various results—sometimes death, but more frequently only a local lesion with slight systemic disturbance. Feeding experiments on sheep with various bacilli isolated were negative.

With guinea-pigs subcutaneous inoculation of the braxy type of bacillus in young cultures in doses of 0·1 to 0·5 c.c. was invariably fatal within 20 hours, often within 16 hours. With smaller doses (0·05 c.c.) death might be delayed a few hours. Small doses of this organism were not pathogenic to rabbits.

The author, however, hesitated to conclude that this braxy type of organism was the cause of the natural disease in sheep, and thus during the years 1915–1917 he carried out his further researches in the field and observed flocks in which cases were liable to occur in order to study the disease in, and obtain materials for inoculation from, sheep immediately after death or killed just before death would have taken place. Twenty sheep were discovered ill at different times and a number of sheep, guinea-pigs, and rabbits were inoculated subcutaneously, or intraperitoneally with blood, exudates, or emulsions of organs etc., removed from the animals directly they had died of the disease, taking precautions to avoid contamination. No distinct reaction was produced even although large doses were often injected. Similarly cultural examinations gave negative results with only four exceptions, viz., one case in which a Coli-like bacillus was isolated

from the liver and mesenteric lymphatic gland, a second case in which a short anaerobe pathogenic to guinea-pigs in large doses but not to sheep was isolated from the hepatic lymphatic gland, a third case in which a short anaerobe non-pathogenic to sheep, guinea-pigs, or rabbits was isolated from the liver, and a fourth case in which an anaerobe producing various results upon inoculation into sheep, fatal to guinea-pigs in rather large doses, but non-pathogenic to rabbits, was isolated from the lung and adrenal gland. These organisms, which were found in exceptional cases, could not be incriminated as the causal organisms. Microscopic examination of smears from organs and tissues likewise gave negative results and similarly histological examination of tissues fixed immediately after death of the animal showed no organisms even although profound structural changes were often observed. No pasteurella organism was discovered in any of the author's cases..

These investigations thus appear to prove conclusively that the braxy-like bacillus discovered in sheep found dead of the so-called black disease soon after death is merely a post-mortem or agonal invader, and the author suggests the probability that the same applies to the anaerobes incriminated as the cause of similar conditions in other parts of Australia and of braxy and bradsot in Europe. Various hypotheses with regard to the etiology of black disease are discussed.

Cross (H. E.). **Some Camel-Feeding Experiments.** — *Agricultural Research Institute, Pusa.*—1918. Bull. No. 77. 8 pp. 1918. Calcutta: Supt. Govt. Ptg., India. [Price As 2 or 3*d.*]

"Our knowledge regarding the quantity of fodder that a camel required is very limited, and no experiments have, so far as I am aware, been carried out to determine the quantity of fodder that a camel requires to keep him in condition. Requests having been frequently made by the military authorities for information regarding the quantity of fodder that should be given to camels, it was decided to carry out some feeding experiments on these animals.

"The only camels available for the purpose were medium-sized camels suffering from surra (7–14 years old). It would have been much more satisfactory had it been possible to carry out the experiments with non-surra-infected camels, but this it was not possible to arrange.

"The camel is an animal that can be trained to eat almost anything, and the fodder on which he feeds varies greatly in different parts of the world. The Punjabi camelmen prefer browsing to stall-feeding, and undoubtedly the camel thrives well if sufficient time is allowed for browsing, and the browsing is of good quality. When the browsing is poor or sufficient time is not available, fodder such as *missa bhusa* (pea straw), *moth bhusa* (*Phaseolus aconitifolius*, straw) and *mung bhusa* (*Phaseolus mungo* straw), and, when in the season, green *tara-mira* (*Eruca sativa*), green *moth* (*Phaseolus aconitifolius*) and green gram are fed to the camels. As a rule the camelman does not feed gram to his camels, being unable to afford it. *Chitta bhusa* (wheat straw) and *phaliyat* (*Eruca sativa* stalks) are occasionally fed. Camelmen however do not like *chitta bhusa* (wheat straw) as a camel fodder and *phaliyat* (*Eruca sativa* stalks) has probably little nutritive value. Without doubt a camel thrives best on fodder and browsing that he has been accustomed to. A camel brought to a district, the browsing in which differs from that to which he has been accustomed or when stall-fed on fodder that he has not been used to, will fall off in conditon; but if he is carefully looked after and only lightly loaded to start with, he quickly becomes accustomed to the change and will rapidly regain his condition.

"Experiments regarding the quantity of fodder a camel will eat were carried out with the following :—

(1) Gram and *missa bhusa.*
(2) *Missa bhusa* without grain.
(3) Gram and *moth bhusa.*
(4) *Moth bhusa* without grain.
(5) Barley, turnips and *moth bhusa.*
(6) Gram and green *tara-mira.*
(7) Green *sarson* (Indian colza).
(8) Oat hay and ordinary hay.

"The camels got poor browsing during the day : the fodder was given in the evening at about 5 p.m.

"Maximum quantity of fodder eaten, in addition to poor browsing.

(1) 12 lb. gram. and 35 lb. *missa bhusa.*
(2) 6 lb. gram and 35 lb. *missa bhusa.*
(3) 39 lb. *missa bhusa.*
(4) 2 lb. gram and 22 lb. *missa bhusa* (2 year old camels).
(5) 6 lb. gram and 40 lb. *moth bhusa.*
(6) 45 lb. *moth bhusa.*
(7) 5 lb. barley, 30 lb. turnips, and 40 lb. *moth bhusa.*
(8) 6 lb. gram and 86 lb. green *tara-mira.*
(9) 192 lb. green *sarson.*
(10) 6 lb. gram and 31 lb. hay.
(11) 17 lb. oat hay.

"*Summary.* The average quantity of fodder eaten, in addition to poor browsing, was as follows :—

(1) 12 lb. gram + 20·6 *missa bhusa.*
(2) 6 lb. gram + 23·1 lb. *missa bhusa.*
(3) 24·9 lb. *missa bhusa.*
(4) 4 lb. gram. + 14·7 *missa bhusa* (2 year old camels).
(5) 6 lb. gram + 26·7 lb. *moth bhusa.*
(6) 29·9 lb. *moth bhusa.*
(7) 5 lb. barley + 26·6 lb. turnips + 26·4 lb. *moth bhusa.*
(8) 6 lb. gram + 66·1 lb. green *tara-mira.*
(9) 135·4 lb. green *sarson.*
(10) 6 lb. gram + 16·2 lb. hay.

"*Conclusions.* Taking into consideration the fact that these experiments were carried out on camels suffering from surra and doing no work, it is probable that healthy camels on hard work would eat very much more. The experiments however show that the present government ration of 16 lb. of a mixture of wheat and *missa bhusa* per camel is insufficient."

Tribondeau (L.). i. **Coloration du sang à l'aide de deux colorants de preparation rapide et facile, genre May-Grünwald et genre Giemsa.** [Staining of Blood Films by Means of May-Grünwald and Giemsa-like Stains, respectively.]—*C. R. Soc. Biol.* 1918. June 22. Vol. 81. No. 12. pp. 639–640.

——. ii. **Coloration du sang à l'aide d'un colorant de préparation rapide et facile, genre biéosinate.** [Staining, etc., by Bieosinate.]—*Ibid.* pp. 641–642.

The method recommended by this author for the manufacture of a Giemsa substitute has already been described in this *Bulletin* (Vol. 6, No. 1, p. 45). The methods of preparation of the products are again briefly indicated in this article.

Preparation of Stain No. 1 (May-Grünwald substitute). Place in a glass vessel capable of withstanding heat

Glycerine (neutral)	5 c.c.
Absolute alcohol (or, if unobtainable, 95 per cent. alcohol)	45 c.c.
Pure medicinal methylene blue	0·2 gramme
French eosin (Pharmacie centrale de France)	0·05 gramme

Close flask by means of a cork perforated by means of a long glass tube, or, if unobtainable, allow flask to remain open. Place the flask in a warmed-up water bath, which is then rapidly boiled. Shake flask in order to accelerate the solution of the staining substances and when totally dissolved withdraw flask from water bath, allow to cool a little, and pour the liquid into a graduated glass vessel. Make up to 50 c.c. with absolute alcohol, or, if unobtainable, 95 per cent. alcohol, filter, place in glass flask.

Preparation of Stain No. 2 (Giemsa substitute).

Place direct in flask

Glycerine (neutral)	25 c.c.
Alcohol (95 per cent.)	15 c.c.
Pure medicinal methylene blue	0·20 gramme
French eosin	0·05 gramme

Dissolve hot as in the case of Stain No. 1. Add 15 c.c. of 95 per cent. alcohol if heating has taken place in a flask left open and not provided with a long tube, in order to compensate for loss of liquid in evaporation. Pour 4 c.c. of ammonia into the stain and mix. Heat in the autoclave at 120° C. for 20 minutes, the neck of the flask being left open. Allow to cool a little, place the stain in a graduated glass vessel, make up to 50 c.c. with 95 per cent. alcohol, place in flask which is not stoppered until after about a day or two.

Process of staining. Fixing. The blood smear, spread in a thin film and allowed to dry is placed flat on a table, film side upwards. Cover with Stain No. 1, place over the slide the lid of a Petri dish in order to guard against too rapid evaporation, allow to act for three minutes. Wash in a jet of distilled water, shake off excess of water, allow slide to rest on the margin of a glass vessel or Petri dish without drying.

Staining. In a small tube graduated to 2 c.c. place 2 c.c. of distilled water, heat in a flame until air bubbles begin to rise, add by means of a pipette 4 or 5 drops of Stain No. 2. Pour hot on smear, allow to act for 15 minutes. Wash in a jar of distilled water, dry by holding over the flame for about 2 seconds and blowing on the preparation.

Differentiation. Pour on the *dry* preparation held inclined a 5 per cent. solution of tannin until the blue colour just turns to red, wash quickly with distilled water and dry rapidly (by heating and blowing).

This method of staining is useful in searching for haematozoa and other blood parasites. It can also be used for routine study of the cytology of the blood. Its great advantage lies in the fact that it can be carried out with any kind of distilled water and precipitates are not thrown down.

ii. This new stain (Stain No. 3) is a neutral solution of eosinate of methylene blue transformed by means of ammonia. It is very easy of preparation.

Preparation of Stain No. 3. Heat distilled water to boiling point and divide as follows :—

A—50 c.c. in an enamelled vessel. Add 0·20 grammes of pure medicinal methylene blue, shake until dissolved.

B—75 c.c. in a glass vessel. Add 0·30 grammes of French eosin. Shake until dissolved.

Pour B little by little into A. Mix for some time with a glass rod after each addition of eosin, then place on a slide the drop remaining suspended to the rod when withdrawn. This is first of a deep blue tint and free from precipitates ; then as the proportion of eosin is increased the blue becomes pale and precipitates appear ; finally the precipitates increase and the liquid turns to a rose colour. Stop the addition of eosin when the colour of a drop becomes pale rose, that is to say, immediately the liquid has turned from blue to red. Ordinarily it requires the addition of rather more than 50 cc. of the eosin solution in order to obtain this result.

Add 4 c.c. of ammonia, mix, heat in an enamelled dish covered with an inverted jar at 120° C. in the autoclave and then allow to become quite cool after having well shaken the stain by means of a glass rod. Filter the mixture through a small filter paper (e.g., about 75 mm. in diameter). The reddish coloured filtrate is thrown away. Withdraw the filter paper from its funnel and place it on several layers of ordinary filter paper so as to form an absorbent pad. Unfold and spread the filter paper in order to facilitate desiccation of the precipitates on its surface. Allow to dry in the incubator at 37° C. The dish utilised in the preparation of the stain is also allowed to dry ; when the filter paper and the dish are absolutely dry (an important condition inasmuch as all the ammonia must have become evaporated) loosen by means of a scalpel the stain adherent to the filter paper and allow it to fall into the dish and crush up by means of a large glass rod. Take 100 c.c. of glycerinised alcohol (absolute alcohol 90 c.c. and glycerine 10 c.c.) and pour little by little into the dish and by agitating with a glass rod there are thus dissolved the stain adhering to the wall of the dish, the staining powder detached from the filter paper and the stain adherent to the paper (crush the paper in contact with the solvent). Place in a well stoppered flask the liquid thus run off successively and carrying with it the still undissolved powder. Allow to dissolve for at least 12 hours, shaking the flask from time to time if possible. Filter through filter paper.

Process of staining. Stain No. 3 is employed like bieosinate.

Fixing. The smear (spread in a thin film, dried, and bordered at one end by a grease pencil mark) is placed horizontally on a table smear side upwards. Cover smear with 0·2 c.c. of the stain (about 4 drops), cover slide with lid of Petri dish, allow to act for 3 minutes.

Staining. Add 0·6 c.c. distilled water (or about 12 drops), mix by moving the slide a few times, then allow to remain horizontal. Allow to act for 10–15 minutes without touching. Wash with distilled water, shake off excess, dry rapidly (by passing for 2 seconds over the flame and blowing strongly on the preparation).

This stain is remarkably selective and complete. It reveals very fine details of cells and parasites that are not shown up in the method first described (notably all the basophile granules of mononuclears). It is the best method for all detailed blood studies, but it has the disadvantage of requiring the use of very pure and neutral distilled water (if necessary re-distilled on carbonate of silver).

REPORTS.

MUKTESAR LABORATORIES. **Annual Report of the Imperial Bacteriologist for the Year ending the 31st March, 1917.** [SHEATHER (A. Leslie).] —25 pp. With 2 tables. 1918. Calcutta: Supt. Govt. Printing. India. [Price annas 5 or 6*d.*]

This is the first Annual Report furnished by Sheather since he took up the duties of Imperial Bacteriologist in October 1916 in succession to the late Colonel HOLMES. The duties of Imperial Bacteriologist up to the time of Sheather's arrival were temporarily carried out by the Assistant Bacteriologist, SHILSTON (A. W.), who presented the preceding report [see this *Bulletin*, Vol. 5, No. 1, p. 66] and has also furnished some important observations on rinderpest [this *Bulletin*, Vol. 5, No 2., p. 120 and Vol. 6, No. 1, p. 25]. The services of the Pathologist and Physiological Chemist were during the year placed at the disposal of the military authorities. In spite of this reduction in the staff, however, the production and issue of serum and vaccines from the laboratories during the year showed a general increase. Details are first given with regard to administration, including new arrangements made for fodder, fuel, and water supplies. The Assistant Bacteriologist made a number of tours for investigation and advisory purposes and with regard to the construction of the new branch laboratory at Izatnagar. The Pathologist (MACALISTER G. H. K.) carried out investigations in connection with "kumri" in Assam.

As in previous years the chief work of the laboratory consisted in the preparation of anti-rinderpest serum. There was an increased demand for this product owing to the prevalence of the disease in nearly all provinces. 1,243,670 doses were prepared and 1,409,220 were issued as against 1,186,550 doses prepared and 969,460 doses issued during the year 1915–1916. In a table the results obtained by the use of the serum in the various provinces are given and inasmuch as the mortality rate among the whole number of inoculated animals amounted only to 0·49 per cent. the author feels "justified in concluding that this serum is of the utmost practical value." Extracts are quoted from the reports of the Superintendents of the Civil Veterinary Departments Assam, Bengal, and United Provinces with regard to the efficacy of the serum in the field.

11,029 doses of anthrax serum were prepared and 29,069 issued as compared with 71,870 doses prepared and 48,337 issued during the preceding year. The manufacture of this serum was regulated according to the demand.

Haemorrhagic septicaemia serum and vaccine.—122,915 doses of serum were manufactured and 157,065 issued during the year under report as against 127,365 doses prepared and 79,965 issued during the preceding year. The number of doses of vaccine prepared and issued during the year was 146,540 as against 124,150 prepared and issued in 1915–1916. There was an increased demand for both these products and steps were taken to augment the supply. Very satisfactory results were reported after the use of the serum by the Superintendent, Civil Veterinary Department, Bombay Presidency; "generally satisfactory results" were also reported after the use of vaccine by the Superintendent, Civil Veterinary Department, United Provinces. The serum is recommended for use to check actual outbreaks of the disease while the vaccine is used in areas where the disease is enzootic at the beginning of the seasons when it is most prevalent.

Blackquarter vaccine.—23,350 doses were issued as against 20,257 doses during the preceding year. Reports from the United Provinces and the Punjab indicate the beneficial results obtained by the use of this product. Strangles serum and vaccine, mallein and tuberculin were also prepared and steps were taken to increase the output of the last-named product. A number of special or autogenous vaccines were also prepared. The routine laboratory work also included diagnosis of a number of morbid specimens received for examination.

A study of the complement fixation test and its application to the diagnosis of dourine in India was taken up by SHILSTON early in the year. The "discovery that this disease was widely established in the Punjab and Baluchistan and threatening seriously to interfere with horse breeding operations, made the working out of a reliable diagnostic method a matter of great importance."

An account is given of inoculation work performed at the Military dairy farms.

"Several factors have combined to limit the amount of research work that could be carried out during the past year. The routine work of the laboratory and the difficulties of administration were greatly increased." A good deal of work was performed with a view to improving the methods of serum production, especially in the case of rinderpest. A report on the disease of horses known as "kumri" has been published by the Pathologist.

Contagious abortion in cattle was reported from some of the military dairies.

Some experiments were performed in connection with pleuro-pneumonia of goats. Also, the treatment of surra was further investigated but without success.

The appearance of foot-and-mouth disease in the animal sheds of the laboratories in November 1916 caused great difficulties in providing accommodation for segregated as well as healthy animals. Additional difficulties were caused by a serious outbreak of relapsing fever among the coolies employed in December 1916 but fortunately by the prompt undertaking of sanitary measures the disease was soon brought under

control. The following table showing the aggregate results from the reports of the various Provinces gives some indication as to the value of the products issued by the laboratories.

Disease	Product employed.	Number of outbreaks in which inoculation was undertaken.	Number of animals which died uninoculated in course of disease.			Number of animals inoculated.			Number of animals which died after inoculation.			Percentage of deaths in inoculated bovines.
			Equines.	Bovines.	Others.	Equines.	Bovines.	Others.	Equines.	Bovines.	Others.	
Rinderpest ..	Serum	3,645	..	57,878	87	..	522,273	810	..	2,611	10	0·49
Anthrax	,,	81	23	547	374	364	6,107	650	..	11	32	0·18
Haemorrhagic Septicaemia	Serum	562	..	4,504	8	..	82,019	292	..	93	..	0·11
	Vaccine	265	..	170	..	..	56,990	..	..	15	..	0·02
Blackquarter ..	Vaccine	93	..	22	..	..	11,042	..	..	38	..	0·03

BENGAL. **Annual Report of the Bengal Veterinary College and of the Civil Veterinary Department, Bengal, for the Year 1916-1917.** [SMITH (A.), Principal and Superintendent.]—4+ii+5+viii+2. With 14 tables. 1917. Calcutta: The Bengal Secretariat Book Depot. [Price 10*d.*]

In the first report the author gives a brief account of the general administration and veterinary instruction at the Bengal Veterinary College, the Epizootic Diseases of Animals Department Calcutta, and the Raymond Research Laboratory. The number of students at the College at the end of the session was 148. There has been a steady increase in the number of students but it appears that there remains a demand in the Presidency for qualified veterinary assistants which is not yet satisfied by the supply of candidates. The three years course in English at the College is provided free of charge but it seems difficult to induce native Bengalis to undertake the studies.

In the report of the Civil Veterinary Department the treatment of diseases and administration of hospitals and dispensaries and breeding operations are described. Cases of glanders, anthrax, and surra were reported among horses. Surra has lately been scheduled under the Glanders and Farcy Acts and it is hoped that destruction of affected animals will tend to the stamping out of the disease.

There was considerably less mortality from rinderpest in the course of the year as compared with previous years and it is stated that even better results could have been obtained if earlier reports of outbreaks were furnished. Foot-and-mouth disease prevailed in almost all districts, and although not so fatal as some other diseases it is a great menace to the agricultural community. The mortality from

haemorrhagic septicaemia was greater than usual—1,957 as against 880 in the previous year. A considerably increased number of animals were inoculated against this disease. A few cases of deaths from blackquarter, anthrax, surra, and some other diseases were reported. The numerous tables appended include statements showing the results of preventive inoculation during the year.

BURMA. **Report on the Civil Veterinary Department (including the Insein Veterinary School) for the Year ended the 31st March 1917.** [EVANS (G. H.), Superintendent.]—13 pp. f'cap. With 7 tables & 1 map. 1917. Rangoon: Office of the Supt. Govt. Printing. Burma. [Price As. 8 or 9*d.*]

During the year under consideration 59 pupils were trained at Insein, where they are put through a three years' course, while a few were also put through a short course at the Veterinary School, Taunggyi, Southern Shan States. Great difficulty was experienced in obtaining suitable candidates for admission to the schools. A large number of interesting specimens were examined at the laboratory of the Insein college.

The most serious diseases appear to have been rinderpest, anthrax, and foot-and-mouth disease, but the year was remarkably free from contagious diseases of cattle. The recorded deaths from rinderpest were only 2,058—a tenth of the mortality from the same disease in 1912–1913. The Akyab and Salween districts were responsible for half the cases; the former district is annually a large contributor to the total number of deaths from this disease and it is hoped to make early arrangements for the adoption of preventive inoculation measures in this district. The number of deaths from rinderpest was considerable in only two of the districts where anti-rinderpest serum was used during the year. Preventive inoculation was also undertaken with success in the Northern Shan States. Foot-and-mouth disease, on the other hand, was more prevalent than in 1915–1916, causing over 5,000 deaths as against 1,800 in that year; it was especially virulent in Bassein, Myaungmya, Kyaukpyu, and Myingyan.

Progress was made in bringing the subordinate establishment up to the sanctioned strength; at the close of the year there were 15 veterinary inspectors and 142 veterinary assistants in Burma proper as compared with 12 and 130 respectively twelve months before. These numbers, however, are quite inadequate to cope with the work owing to the large extent of the areas now under the control of individual assistants.

Breeding operations appear to be at a standstill.

In the map given the areas affected by the principal contagious diseases are indicated.

UNION OF SOUTH AFRICA. **Department of Agriculture. Report with Appendices for the Year ended 31st March, 1917.**—158 pp. f'cap. 1918. Cape Town: Cape Times, Ltd. [Price 4*s.* 3*d.*] (Appendix III. Veterinary Research. Annual Report of the Director [THEILER (A.),] 1916–1917. pp. 45–50.)

In this important report an account is first given of the very considerable routine work performed at the Onderstepoort Laboratory

and the branch laboratories at Grahamstown and Pietermaritzburg. This includes visits made for purposes of investigation into various districts within the Union of South Africa by members of the research staff. The following summary account of the work done in connection with the various diseases prevailing in South Africa is reprinted in full as one could not very well do justice to it in an abstract.

"*Microscopical and Pathological Anatomical Examinations.*—The total number of specimens and smears examined at the three laboratories amounted to 21,779, an increase of 45 per cent. over the previous twelve months. The distribution was 13,556 at Onderstepoort, 937 at Grahamstown, and 7,286 at Pietermaritzburg. At Onderstepoort this branch of the routine work occupies a good part of the time of three of my Research Officers, and leaves them but little opportunity for research work. At Pietermaritzburg, where there is only one Research Officer, this work constitutes even a heavier drain on his time, and as soon as opportunity permits, I intend placing another officer there.

"*Blue Tongue Vaccine.*—1,244,050 doses were issued during the year under review. This figure shows a slight falling off when compared with that of the previous 12 months, but brings the total issues up to 6,860,589 doses since the method was first introduced. I am glad to report that notwithstanding the numerous difficulties we had in coping with the heavy demands no untoward results were reported from the practice.

"*Redwater and Gallsickness Vaccine.*—The total issues of this vaccine from the three laboratories amounted to 18,069 doses, the distribution being 7,222 doses from Onderstepoort, 6,357 doses from Grahamstown, and 4,490 doses from Pietermaritzburg. The total output shows an increase of 60 per cent over the previous year.

"*Anthrax Vaccine.*—The preparation of Anthrax vaccine at Onderstepoort was continued, and our supplies from the Institute Pasteur, Paris, were reduced to a minimum. Out of the total number of 696,850 doses that were issued during the year 632,350 doses were prepared at Onderstepoort, the balance of 64,500 being imported from Paris. The issue this year broke all records, being an increase of over 70 per cent. on the output for 1915–16, and my limited staff was taxed to the utmost to comply with the demand. When it is considered that in the five years from 1911 to 1916 only 828,355 doses were supplied and yet in the 12 months under review 696,850 doses were issued, of which 91 per cent. was prepared at Onderstepoort, it will be readily understood that complaints of delays could not be avoided. I was unable to obtain the services of any extra officer to cope with this extra work, and the only additional facility that was available was the newly erected Anthrax Vaccine building.

"The issues during the year 1916–17 consisted almost entirely of the method known as the single vaccine, for which only one injection was necessary, but by the end of the year it had become evident that the single method, generally speaking, was not so satisfactory as the double method for which two injections are necessary. Naturally, the re-introduction of the double method involves exactly double the work, but luckily the difficulty experienced last year by reason of the shortage of bottles and tubes has now been overcome to a large extent, and it is hoped that if farmers return empty bottles, our stock will suffice for requirements. I am also glad to be able to report that, generally speaking, the results of the vaccine were as satisfactory as could be hoped for.

"*Black Quarter Vaccine.*—The number of doses prepared at Onderstepoort and issued during the current year amounted to 223,896, again an appreciable increase on the corresponding figure for 1915–16, namely 185,830.

"*Inoculation of Mules against Horse-sickness.*—The number of mules inoculated during the period under review was very small, comparatively speaking, only 295 being done, four deaths occurring, or 1·4 per cent.

"*Inoculation of Horses against Horse-sickness.*—The improved method of inoculation of horses was introduced in the practice in September 1916, after it had been ascertained from both experiments at the Laboratory,

and experience at Roberts' Heights on horses belonging to the Military, that the results were likely to be satisfactory. Some 400 horses were inoculated at the Laboratory with a mortality of 3·5 per cent., whilst at Roberts' Heights, 1,609 were inoculated with a mortality of 4·5 per cent. Between September and December 1916, some 1,250 horses were inoculated for farmers, the mortality being 7 per cent., but unfortunately by the time the last batch was inoculated, reports had been received to the effect that deaths were occurring from some unknown cause in those batches of horses that were done at the commencement. Inquiries were immediately instituted, and before very long it became quite evident that this new disease was one known as Staggers, and as this disease appeared amongst each batch of horses at the different inoculation centres about 2 months later, there were some grounds for supposing that the inoculation was connected with Staggers in some way or other. Later investigations made it quite clear that the serum and virus used for the inoculation were not the actual cause of Staggers, but that the fever resulting from inoculation was probably responsible for bringing out this disease in horses that might otherwise not have developed it. This theory, therefore, presupposes a derangement of the liver in horses at the time of inoculation, but our inquiries have not yet been completed, and these views may be modified at a later date.

"It is of particular importance to record that cases of Staggers have recently been brought to my notice by farmers amongst horses that were never inoculated, but that are supposed to have salted in previous years. Cases of Staggers have also occurred amongst uninoculated horses kept at this Laboratory, and amongst uninoculated horses belonging to the Military Authorities. It is hoped that further investigations, with particular reference to material from these cases, may help to elucidate the cause.

"Although the Government was not legally liable for the payment of compensation in respect of horses that contracted Staggers after inoculation, yet I considered it very desirable to recommend the adoption of such a principle on the ground that it was impossible to warn the farmer at the time of inoculation that such a contingency might be expected. All claims for compensation have been closely scrutinised and, with very few exceptions, all claims have been settled, either by the payment of cash to the amount for which the horse was insured at the time of inoculation, or by the issue of an inoculated horse of the equivalent value in lieu. Up to the 31st March 1917, just over 150 claims had been approved, and it is anticipated that by the time all claims have been received, compensation will have to be paid for about 200 horses. The total amount involved in the payment of compensation will probably be about £3,000, but as I pointed out at the time my recommendations were made, I considered the principle of paying compensation would show the farmers that we were doing our best to help them out of the difficulty and, what is of more importance, would restore their faith in the method of inoculation.

"The outbreak of this new disease was a very severe blow to me, and is, in fact, the most disheartening incident that has occurred in the whole of my investigations into Horse-sickness. The mortality from inoculation was quite reasonable, and as will be seen from the figures quoted above, under the worst conditions under 7 per cent. of the horses that were inoculated died under the treatment, whilst in regard to the immunity, this was the best that had been given by any of our methods.

"The immunity tests this year were undertaken in two places, first of all at Onderstepoort and at Doornpoort a farm adjoining our Laboratory, where 216 inoculated horses were exposed during the summer months, amongst which a mortality occurred to the extent of 4 per cent. The second batch of horses, numbering 50 were exposed in a very unhealthy area at Enselini in Zululand, and in this batch also the mortality only amounted to 4 per cent

"*Wire- and Tape-worms in Sheep and Lambs.*—The introduction of a new remedy for the treatment of wire-worms and tape-worms in sheep and lambs was commenced at the beginning of March 1917, and up to the end of the month 200,000 doses had been issued. Before introducing the remedy into practice on a large scale, Mr. Robertson, M.P.C., of

Amersfoort, kindly offered to subject the remedy to an extensive test on his farm, and I am glad to report that favourable results were obtained by him. In order to obtain the desired results, it is essential that the remedy should be given in the doses prescribed, and for this purpose sets of spoons have been made to my specification, each spoon marked in a distinctive manner and holding the exact dose for lambs and sheep of various ages. A dosing bowl is also supplied to facilitate the handling of the powder, and both spoons and dosing bowls are manufactured by a private firm. These articles are retailed to the farmers at practically cost price.

"*Research work.*—The lack of professional staff has prevented me from undertaking detailed research work into many of the diseases that require investigation, but notwithstanding our many difficulties I am glad to say that we have had positive results from two of our investigations, namely, Jagziekte in horses and Geeldikkop in sheep. A short review of the lines on which research work was undertaken is given under their respective headings.

"*Horse-sickness.*—Experiments were undertaken with a view to simplifying the method of inoculation and of conferring a better immunity to horses. The results proved very satisfactory in the experimental inoculations, a mortality of under 4 per cent. occurring during treatment, whilst the immunity held to the extent of 96 per cent. In other words we could safely expect to save 9 out of 10 horses. Unfortunately, as I have reported earlier, when the method was introduced into the practice a sequel occurred, a new disease, Staggers, making its appearance amongst inoculated horses to the extent of about 15 per cent.

"*Slapziekte in Horses.*—Investigations were made in the Griqualand area into a disease known as Slapziekte and the opinion has been arrived at that the disease is that known in other countries as Dourine. All attempts to transmit the disease artificially into control animals have so far failed, but research is being continued.

"*Jagziekte in Horses.*—With a view to comparing the flora on farms where the disease is known, Mr. Pole Evans, the Chief, Division of Botany, accompanied me on several visits to various farms in Natal. Experiments were continued with a view to ascertaining the cause and manner of transmission of this disease, and just before the close of the financial year the third successful attempt at transmitting the disease artificially was achieved. Although the enquiries are by no means completed, it seems evident that the disease is contracted by eating a plant Crotolaria dura, which is only known in certain parts of Natal where the diseases exist. I would also like to mention that it was due to the observations of Mr. Rabe of Singletree, Natal, that we were able to solve the cause of this disease.

"*Dunziekte in Horses.*—Experiments with a view to ascertaining the cause and nature of the disease were continued, 50 horses being exposed in Mooi River, Natal. So far no positive results have been obtained.

"*Miscellaneous Horse Diseases.*—Various investigations and some control experiments have been undertaken into diseases of horses such as Staggers, which appeared in connection with the inoculation against Horse-sickness and Pernicious Anaemia.

"*Anthrax.*—With a view to overcoming the difficulty experienced in the past as a result of incomplete immunity given by the Anthrax vaccine obtained from the Institute Pasteur, experiments were made to increase the dose of vaccine to be injected, and a new procedure has now been adopted on these lines.

"Attention was paid to the possibility of Anthrax infection existing in dams and numerous attempts were made to reproduce the diseases by the injection of animals with muddy water taken from suspected dams. So far three positive results have been obtained. These results are very interesting as they show the extent to which Anthrax infection must be prevalent.

"*Trypanosomiasis (Tsetse disease, Nagana).*—Mr. Mitchell, the Veterinary Research Officer at Pietermaritzburg, was detailed to make a thorough enquiry into the prevalence and spread of Nagana in Zululand, and his preliminary report has been submitted.

"Experimental inoculations into small animals were also undertaken at the Laboratory in Pietermaritzburg to determine species and infectivity of the parasites.

"*Lamziekte in Cattle.*—Attempts were made at Onderstepoort to reproduce Lamziekte by allowing cattle to lick soil from Lamziekte areas, and also by letting them graze on such soil spread over our own veld. No results were obtained.

"Research into Lamziekte at Vryburg has been hampered owing to the lack of suitable accommodation, but arrangements have now been made for the erection of some of the buildings to be put in hand without delay.

"Out of the various experiments that were undertaken at Vryburg the only point of any practical importance that was arrived at was, that the feeding of cattle with good foodstuffs and licks did not seem to ward off the disease. The opinion that the disease is connected with the pasture has again been supported by our observations.

"It had originally been arranged that some experiments into Lamziekte should be undertaken at Bestersput, O.F.S., but, unfortunately, the idea had to be given up chiefly owing to the shortage of staff. The farm has been used for the grazing of stock and only minor farming operations have been undertaken.

"*Imapunga in Cattle (or Black Lung).*—The experiment commenced in 1915 on the farm Palmerston near Grahamstown, had to be discontinued owing to the disease failing to put in an appearance. Mr. Robertson, the Veterinary Research Officer at Grahamstown, made enquiries with a view to ascertaining if there was another suitable farm, and as a result Mr. White, the owner of the farm Palmiet was good enough to place his farm at our disposal. Some 50 head of cattle were exposed there and arrangements were made for inoculation and drenching experiments in the Grahamstown laboratory. No disease appeared, however, by the end of the year, and it seemed generally to be in abeyance throughout the whole area.

"*Stijfziekte in Cattle.*—Through the assistance of the Chief of the Division of Botany, Mr. Pole Evans, a number of farms in Natal were inspected and extensive notes made concerning the distribution of the various plants and grasses. At one of the farms so inspected, namely, Lidgetton, Mr. Thompson, the owner, was good enough to offer the Division his assistance, and as a result an experiment was undertaken to see whether cattle obtained from a clean area would contract Stijfziekte when exposed on that farm, and if so, after what period. The results were that within 6 months after exposure about 50 per cent. of the cattle contracted the disease.

"At the same time a number of cattle suffering from Stijfziekte were purchased from Mr. Thompson and removed to the Laboratory at Onderstepoort with the object of ascertaining whether such animals would improve in condition after being removed from the farm, and how long it would be before recovery was complete. Although the experiments are by no means completed, it seems fairly conclusive that if cattle suffering from Stijfziekte are removed to a clean farm, and fed on good rations the majority recover.

"*Contagious Abortion in Cattle.*—Investigations were continued into several points of interest especially in connection with the length of time cattle remain infected with this disease. Valuable information is at hand and will be published in the next annual report.

"*Gauwziekte in Sheep.*—An opportunity of investigating this disease was afforded through the assistance of Mr. Strydom, of Kaalfontein, near Pretoria. Different batches of sheep were exposed on this farm for varying periods, and then returned to Onderstepoort and kept under observation. At the same time feeding experiments were undertaken at the laboratory with plants that Mr. Pole Evans considered might be responsible. No results were obtained before the end of the financial year.

"*Geeldikkop in Sheep.*—Through the kindness of Mr. du Preez, of Bergrivier, Luckhoff district, an excellent opportunity occurred for carrying our further experiments into a disease in sheep known as

Geeldikkop, that is very prevalent in the Karroo. In the opinion of the farmers the disease was due to sheep eating a plant known as Dubbeltje, and although experimental tests had been carried out on several occasions previously with negative results, it was considered advisable to carry out a thorough feeding test with this plant in its fresh state, and I am glad to be able to report that our efforts were successful. The disease appeared promptly after a batch of sheep were fed on the dubbeltje and the explanation for our previous failures must lie in the fact that the plant only produces the disease when fresh and in a particular stage of its growth.

"I am indebted to Mr. Pole Evans for his valuable assistance in undertaking the Botanical survey of the farm in question.

"*Paralysis in Ostriches.*—With a view to ascertaining whether paralysis in ostriches is due to the wire-worm infection an experiment was commenced in Grahamstown in which numbers of these parasites were fed to birds, and it appears that an extensive infection is the cause."

UNION OF SOUTH AFRICA. **Department of Agriculture. Report with Appendices for the Year ended 31st March, 1917.**—158 pp. f'cap. 1918. Cape Town: Cape Times, Ltd. [Price 4*s.* 3*d.*] (Appendix I. Veterinary Division. Annual Report, 1916–17 [BORTHWICK (J. D.)], Acting Principal Veterinary Officer], pp. 29–38.)

In the absence of the Principal Veterinary Officer (GRAY (C. E.) in German East Africa on special duty in connection with the outbreak of rinderpest in that country [see this *Bulletin*, 1918, Vol. 6, No. 2, pp. 115–118] the report of the Veterinary Division is furnished by Borthwick (J. D.).

East Coast Fever continues to take up most of the time of the officers of the Division. Taking the Union as a whole the position has improved but in the separate provinces the outlook is regarded as being none too bright.

Cape Province is fortunate in having had no fresh outbreaks during the year. There remain only two areas under quarantine, viz., in the Komgha district, and as no cases of the disease had occurred in this district since the preceding May it is hoped that the whole of the Cape Province may be declared entirely free of East Coast Fever shortly. The existence of the disease in the bordering Transkeian districts still remains a serious cause of anxiety.

Transvaal. Although the number of fresh outbreaks is 11 less than in the preceding year the position is rather disappointing as the disease developed alarmingly in the Pietersburg district (12 fresh outbreaks) where it was considered well under control. There were also 8 new outbreaks in the Barberton district but the rugged nature of this district makes the task of combating the disease a difficult one. In the first named district the spread of the disease is stated to have been entirely due to lack of co-operation on the part of farmers. The author gives particulars of four serious outbreaks the presence of which had been hidden as long as possible or dipping had been performed just sufficiently to check mortality. In the meantime infection had spread through the medium of joint dipping and grazing to other farms. It is hoped that the further spread of the disease will be checked when farmers have become more enlightened as to the urgent necessity of regulation dipping. In the Zoutpansberg district only 1 death occurred but unfortunately it kept a large native area in quarantine. The Waterberg district unfortunately became re-infected but owing

to prompt measures the outbreak remained circumscribed. In the Piet Retief district very good progress was made and this is attributed entirely to the fact that the district is now well provided with tanks. No new outbreaks occurred in the Ermelo district which in all probability will shortly be declared clean. Seven fresh outbreaks occurred in the Carolina district and here control is difficult as only a few of the farms are inhabited by Europeans. On one farm where no dipping facilities were available the natives were persuaded to slaughter off the whole of the infected herd.

Natal. Owing to the fact that so many districts are infected the position is dealt with in a general way. It is regretted that the progress made towards the eradication of the disease in this province is somewhat disappointing, and this state of affairs is attributed largely to the fact that there are so many absentee landlords. The number of outbreaks occurring during the year was 126 as against 91 in the previous year, and here again many of them had been in existence for a considerable time before they were detected. In a good many instances where the disease was diagnosed early and 3 day dipping and hand dressing promptly adopted beneficial results were obtained. In a country like Natal the difficulties of making an early diagnosis in the case of outbreaks of disease such as East Coast Fever are considerable and especially when the farmer fails to do his part in assisting the officers of the Department. As the majority of cases do not come to light until they have been in existence for some time and the adult brown tick is prevalent and consequently infected, five-day dipping is now enforced in preference to three-day dipping. Doubtless three-day dipping gives good results in the hands of farmers who attend to all necessary details but in general practice five-day dipping gives better results; it is stated that even if the dip employed in the five-day system is below strength it still has a chance of retaining its tick destroying properties whereas the three-day dip slightly below strength is far too weak to ensure the desired result. [It is assumed that the dip recommended for use in five-day dipping is stronger than that used in the three-day system. Ed.] In both cases hand dressing is essential. As a further precaution in cases where quarantine might have been raised too early, movements of cattle from recently released properties are only permitted provided the cattle can be kept under observation for 30 days on an approved property at their destination. Special consideration is given to cases where the infection is slight, and ox transport is only permitted within the owners' property. Progress is made in the erection of dipping tanks but difficulty is experienced on account of absentee landlords. It has been found necessary to stop to a large extent the holding of central public sales. In one or two isolated cases the slaughter of surviving cattle has been resorted to as a means of exterminating the disease.

Considerable progress has been made in the Transkeian Territories during the year and as a consequence the cattle are steadily increasing in numbers in the majority of districts. The natives generally are realising the advantages of efficient dipping and the Transkeian General Council is exerting every effort to provide funds for the erection of as many tanks as possible. The sum of £10,000 is being placed on the estimates for the coming year for this purpose. The working

of these tanks has been placed under the direction of the Veterinary Division whose intention is to attend to the border districts first, in order to create a belt of clean areas which would act as a buffer for the adjoining districts of the Cape proper and Natal.

Tuberculosis. Owing to lack of funds and shortage of staff the endeavours of the Department to eradicate this disease were seriously handicapped. The question of increasing the amount of compensation payable under the Act has again been brought forward for discussion but as yet no decision has been arrived at. In the four closed districts of Cape Province 4,695 cattle were subjected to the tuberculin test before removal to other districts; 137 reacted and were destroyed, giving a percentage of 2·92 reactors. In the Transvaal there were 18 outbreaks as against 13 during the previous year; 663 cattle were tested, of which 39 reacted and were destroyed. The number of outbreaks, however, by no means indicates the true position as regards the prevalence of the disease in the Transvaal as it was found impossible to make a study of its distribution.

In Natal 4 outbreaks were dealt with; 1,339 cattle were tested of which 75 reacted. In the Transkei it was found possible to test one herd only of 360 animals; 47 reacted. No outbreaks were dealt with in the Orange Free State. Owing to the war the arrangements made for the application of the tuberculin test overseas in the case of animals intended for import have not been made use of; 455 cattle were tested at the ports of entry, 16 reacted and were destroyed.

Anthrax. This disease is responsible for more losses among stock than all the other contagious diseases put together with the exception of East Coast Fever, and it appears to be spreading rapidly throughout the Union and is becoming a serious menace to both human and animal life. This state of affairs is largely due to the negligence on the part of farmers and natives especially, inasmuch as carcases of affected animals are not buried intact. In some districts of the Transvaal anthrax is very prevalent; the skinning and opening of the carcase of an animal found suddenly dead should not be permitted until examination of a blood smear has proved that the animal did not die of anthrax. The advisability of applying this regulation to the whole of the Union is a matter that will have to be considered.

"*Glanders.* With the exception of the Cape Province, this disease, ... is not very prevalent in the Union. Glanders is the usual war legacy, and the present war is no exception, and accounts for the increase in the number of outbreaks in the Cape Province, where military horses and mules, sold after the German South-West African Campaign, were distributed.

"An epidemic of influenza affecting equines, a disease which conceals the symptoms of Glanders, further abetted the spread of the disease.

"*Lungsickness.* No cases of this disease were reported in the Union during the year.

"*Equine Scabies* (*Mange*). With the exception of the Cape and Transvaal, this disease is not very prevalent in the Union. . . . In the Cape Province it is chiefly prevalent in Humansdorp, Uitenhage, and Port Elizabeth districts, most of the affected animals being donkeys owned by poor whites and coloured people.

"*Epizootic Lymphangitis.* This disease is only slightly prevalent in the Union, chiefly in the Humansdorp district in the Cape Province. The most expedient, economic and effective method of dealing with this disease is to destroy the affected animals.

"*Contagious Abortion.* This disease is somewhat prevalent throughout the Union, and its eradication presents some difficulty, as the quarantine policy is, unfortunately, not one that attracts the co-operation and support of the farmers in the detection of the disease. During the year 46 cases have been reported, the agglutination test being applied in most cases.

"*Trypanosomiasis.* Nine cases of this disease were reported in Natal during the year—one in Entonjaneni District, and eight in the Lower Umfolozi District. The infected animals, 20 in number, were 14 cattle, 5 donkeys, and 1 mule.

"*Swine Fever.* Only one outbreak of this disease was reported, it occurred in the Transvaal, and even in this solitary case, owing to the ultimate result thereof, there is an element of doubt as to whether the disease was really Swine Fever.

"*Dourine.* On account of the detection of a suspected outbreak of 'Dourine' in the district of Herbert, Cape Province, this disease was added to the list of diseases scheduled under the Animal Diseases Act, in order that the Minister might have the necessary legal power to deal with animals suspected of being infected with it. Investigations are still proceeding in connection with the suspected outbreak in Herbert.

"It is a disease of considerable economic importance. Treatment is unavailing, and the destruction of the infected animals, with payment of compensation, is the only effective method of preventing its spread.

"*Redwater.* This disease is reported as spreading in the south-western districts of the Cape Province, more especially in the Caledon and Swellendam Districts. In the Orange Free State, where at one time it was not known to exist, it has appeared in the Senekal and Ladybrand Districts.

"*Geeldikkop.* Owing to the drought this disease, which is generally so prevalent in the Orange Free State and Cape Provinces, was not so prevalent this year, more especially in the latter Province. Investigations as to the true nature and cause of this disease are still proceeding.

"*Quarter Evil.* This disease was very prevalent in the Transvaal, and caused considerable loss to the farmers. In the Transkei, however, it was not so prevalent. Inoculation was carried out to a large extent, and the officers of the Division gave several inoculation demonstrations for the benefit of the farmers and natives with, it is considered, very good results.

"*Blue Tongue.* This disease has been less severe, especially in the Cape Province, where probably the drought influenced its prevalence. Inoculation was carried out to a great extent.

"*Horsesickness.* This disease was again to the fore in the Transvaal, and caused heavy losses. A large number of equines were inoculated by the Veterinary Officer, but, unfortunately, losses from a form of 'staggers' ensued, and the method had to be stopped, in so far as horses were concerned.

"*Dunziekte.* In the Transkei, more especially in Mount Currie District, this disease was the cause of a considerable mortality amongst equines. Investigations in connection therewith are at present engaging the attention of the Veterinary Research Division.

"*Mealie Poisoning.* In August last, in the Estcourt Division, Natal, serious illness and many deaths were reported amongst cattle which had been turned into mealie fields. A quantity of 'mouldy' mealies were picked up on the fields and sent to the Allerton Laboratory for experiments, with the result that it was definitely proved that 'mouldy' mealies are poisonous. No medicinal treatment appears to be of any avail, but the farmer, of course, has the remedy in his own hands—*i.e.*, the removal of all such diseased mealies from the fields before the cattle are turned into them."

Some notes are then added with regard to the importation of slaughter cattle from adjoining territories, the export of beef, the number of prosecutions and the constitution of the professional staff for the year under consideration.

SOUTHERN RHODESIA. **Abridged Report of the Director of Agriculture for the Year 1917.**—6 pp. f'cap. 1918. Presented to the Legislative Council. **(Abridged Report of the Chief Veterinary Surgeon** [SINCLAIR (J. M.)], pp. 4–6 f'cap.)

East Coast Fever.—The incidence and methods adopted for the control of this disease in seven districts are detailed. The following general remarks are added as the result of the experience gained:—

"The number of fresh outbreaks during the year was 13, with a mortality of 43 head, as compared with 20 and 382 respectively for the previous year.

"Short interval dipping is one of the most effective methods at our disposal of dealing with Coast Fever. 'No ticks, no Coast Fever' is axiomatic, but under local conditions the former state is impossible of achievement. The complete eradication of infection is possible, however. It has been eradicated from many districts in Rhodesia and the Union, and it can be eradicated from those in which it at present exists. I have no hesitation in saying that if every area carrying infected ticks could be accurately defined the disease would be eradicated within a period of two years by our present methods. It may well be asked why these areas cannot be so defined and dealt with. The reply is, to my mind, very simple. In the majority of cases the disease has been in existence for several months (two years in the Engwa case) before it is brought to our notice. Meantime infection has been disseminated, which may and frequently does not manifest itself for another extended period, and so the cycle goes on, with the result that we are generally at the heels of the disease instead of in front of it. In dealing with the outbreaks, the known infected areas are a comparatively simple proposition; the unknown and unsuspected we cannot combat. To remedy this state of affairs universal compulsory effective dipping of cattle throughout the Territory has been proposed. Whilst the value of the proper use of the dipping tanks is fully recognised, it may be stated as a fact, and not as a matter of opinion, that weekly dipping, however effectively practised, will neither eradicate Coast Fever nor prevent its spread. It is true that as ticks are reduced in numbers by dipping the chance of the disease being propagated and disseminated is correspondingly lessened; at the same time dipping may mask infection for an indefinite period and result in recrudescences on areas where it had been regarded as a thing of the past and in fresh outbreaks on previously clean areas. This point of view is clearly and concisely expressed in the Supplementary Report of the African Coast Fever Committee as follows:—'Such dipping may prevent any noticeable number of deaths when Coast Fever exists, yet cattle moved from such areas may and have been the cause of carrying the infection with them.'"

"These remarks are not to be taken as reflecting any doubt in the writer's mind as to the value of dipping as a general prophylactic measure; they are simply intended to forestall the disappointment which is bound to result if a scheme of universal compulsory dipping at seven day intervals is relied upon for the eradication of Coast Fever.

"*Quarter-Evil.*—The mortality from this disease, which began in November, 1916, persisted throughout the year, in Matabeleland a total of 133 deaths being reported.

"*Anthrax.*—Three outbreaks occurred on farms in the Mazoe and Salisbury districts. The diseased carcases were cremated and the in-contact animals, 615 head, vaccinated. The total mortality was 9 head.

"*Tuberculosis.*—Although no case of the disease came under the observation of the Department, several head of Rhodesian cattle shewed tuberculosis lesions on *post-mortem* inspection at the Johannesburg abattoirs.

"*Contagious Abortion.*—The existence of infection was diagnosed in four herds. Unfortunately there is no satisfactory method of treatment capable of adaptation to local circumstances, but, as far as possible, infected animals are isolated, the aborted foetuses destroyed, and the farm or area involved placed in quarantine for an extended period.

"*Fluke Disease of Cattle.*—This affection appears to be increasing. During the drought a heavy mortality occurred in various districts. A few animals were treated with *Extractum liquidum filicis*, B.P., with most promising results. Owing to shortage of staff and the difficulty of obtaining this material the observations could not be carried on; they will, however, be resumed when conditions are more favourable.

"*Horse Sickness.*—The total mortality reported was 107 head, mostly horses. As most of the mules in the country and a considerable number of horses have been immunised, and as many horses possess a certain degree of resistance from several years' exposure to infection, this mortality indicates a very heavy infection during the season.

"*Sheep Diseases.*—Very few cases of blue tongue occurred and these were of a mild nature. A slight mortality, less than 3 per cent., occurred on one farm in the Melsetter district.

"*Rinderpest.*—Early in the year reports were received from Veterinary Officer Hooper-Sharpe attached to General Northey's Column in East Africa, that as a result of the many movements of cattle caused by the military operations rinderpest infection was spreading towards the border of Northern Rhodesia. Full reports of the excellent work done by this officer, under the most trying and difficult conditions, have already been submitted. The magnitude of the work of dealing with rinderpest in such a large area and the menace to the whole of South Africa by the southward spread of infection were realised by all the Administrations concerned, and Mr. C. E. Gray, Principal Veterinary Officer of the Union, was appointed Commissioner in charge of operations, and proceeded to East Africa with a staff of veterinary surgeons and complete equipment. The latest reports shew that satisfactory progress has been made in combating the disease and that there has been no further extension southward."

BRITISH GUIANA. **Report of the Department of Science and Agriculture, for the Year 1916.**—133 pp. f'cap. 1917. Georgetown, Demerara: The "Argosy" Company, Ltd. (Appendix IV. Veterinary Division [MILNE (A. Seton), Government Veterinary Surgeon], pp. 75–78 f'cap.)

The general health of stock in the Colony during the year ending 31st December 1916 is stated to have been excellent. The only outbreaks of contagious disease were of anthrax and swine fever, and these were very soon brought under control. The measures adopted for combating the small outbreaks of anthrax are indicated. No deaths among mules from anthrax have occurred for over two years, and this is attributed to the fact that imported mules are vaccinated against the disease as soon as they land in the country. In addition all the mules on the sugar estates are vaccinated once a year. Six outbreaks of anthrax involving 34 deaths occurred among cattle. No cases of swine fever have occurred for two years except on two restricted areas. No cases of glanders have occurred for three years; the disease has apparently been stamped out by the use of mallein in formerly infected centres. Cerebro-spinal meningitis which carried off a large number of mules a few years ago has not again made its appearance for over three years. Also no cases of contagious pleuro-pneumonia have occurred for 20 months. A few details regarding breeding operations with cattle, pigs, and horses are given.

A pedigree shorthorn bull affected with trypanosomiasis was successfully treated by the administration of a preparation called sodium protosanate received from the Instituto Oswaldo Cruz, Brazil. The trypanosomes were stated to resemble the causal organism of mal de caderas. The animal was badly affected at the time when

the drug was injected intravenously, but the temperature dropped and the animal became almost normal in appearance within 24 hours of the first injection. Two injections were given afterwards at four days' intervals, and subsequently the animal remained in good health while under observation for a period of over 18 months. Every imported animal that had been affected with trypanosomiasis prior to this bull was lost. It is hoped that the above preparation will be successful in the treatment of mules affected with trypanosomiasis as large numbers of valuable mules succumbed to mal de caderas in 1913–1914 in the Colony.

Book Review.

Crocker (Walter J.) [B.S.A., V.M.D.] (Professor of Veterinary Pathology, School of Veterinary Medicine, University of Pennsylvania). **Veterinary Post-Mortem Technic.**—xiv + 233 pp. With 142 illustrations. 1918. Philadelphia & London: J. B. Lippincott Co. [Price 16*s.* net.]

This book is stated to have been written "in an endeavour to fill a gap in the American veterinary literature which has long been felt by the writer in teaching post-mortem pathology." In the opening chapter some useful information is given with regard to the precautions that should be taken prior to holding an examination in order to safeguard the operator from the legal stand-point and also against accidental infection; the regulations in force in the United States of America in connection with the forwarding of diseased specimens by post or rail are enumerated. Succeeding chapters are devoted to the structure and equipment of the post-mortem room and a description of a number of instruments said to be required for post-mortem work. After dealing briefly with the external examination of the carcase the author passes on to a minute description of the best methods for exposing all the internal organs of the horse. The internal examinations of ruminants, pigs, and the dog and cat are dealt with at somewhat less length; a few remarks on the procedure recommended in the case of the mouse, guinea-pig, rabbit, fowl, and elephant are then given. The student is next instructed in the manner of describing each organ separately after its removal from the carcase and included in this chapter are a number of useful descriptive tables of the normal organs of the various domesticated animals. The book closes with a series of specimen forms indicating briefly the manner in which post-mortem reports should be furnished.

In a subject like veterinary science, remarkable for the paucity of good text-books, especially for students, an endeavour to elucidate any branch by means of a systematic work such as the one under review cannot but be commended. The author has claim to many years' experience in teaching post-mortem pathology in one of the leading American schools and rightly regards it as a subject worthy of great consideration in the curricula of schools of veterinary medicine. Thoroughness in actual work is strongly insisted upon and with this object groups of students are told off to display all the anatomic structures of the various regions of the dead animal and report upon their macroscopic appearances. Such a painstaking procedure is no doubt much to be desired in places where proper facilities for the work exist. The extent to which the examination should be carried may be gauged from the following:—"In every autopsy one of the long bones containing yellow bone-marrow should be sawed in two parts longitudinally or split with an axe. Another should be sawed crosswise in several places." Apart from being of great value in the

training of students "regular systematic post-mortems should be made and accurately recorded at every veterinary school and hospital for the accumulation of valuable data which are of great scientific and geographical interest." Also, "to avoid the oversight of some obscure though important disease process an exact and painstaking system of technic must be developed." There is no doubt but that an important disease of cattle like Johne's disease was frequently attributed by specialists to more obvious morbid processes such as parasitic gastritis until a more thorough examination of the bowel revealed the true nature of the disease. Moreover, workers dealing with certain diseases in which the lesions are ill-defined are tempted to described morbid changes such as congestion where there are no such changes, merely through lack of sufficient experience of the normal appearances of the parts in question. Many investigators in dealing with equine infectious anaemia describe characteristic lesions in the bone marrow; THEILER and his assistants in the course of systematic post-mortem work, such as is recommended by the author, in South Africa demonstrated that such changes were by no means constant in the disease and could even be seen perhaps as frequently in animals suffering from other diseases or in healthy animals. One is also struck with the ignorance often displayed by students, who have just passed through a course of anatomy, regarding the normal disposition of organs, such as the mesenteric glands in the horse and ox, that play a prominent part in several important diseased processes, although—as the author states—they "may speak most learnedly of the Malpighian corpuscles and the islands of Langerhans."

The adoption of such a thorough method of examination, although so much to be desired from the stand-point of the student or the specialist, is by no means realisable in the case of the busy practioner working under such rough conditions as are usually to be obtained in the field or in the knacker's yard. Indeed, even if he had the time it would be of doubtful advantage to him to prosecute his labours to the recommended degree of detail. Practitioners usually post-mortem animals for the most part dead of some common condition diagnosed during life as colic or pneumonia and all they require is to expose the bowels or lungs to confirm the diagnosis they had made or obtain some knowledge that would prove of value to them in further diagnosis. This practice should not be discouraged on account of lack of proper facilities. An appreciation of the proper significance of the more intricate morbid changes, however, is so much the result of prolonged training that it would perhaps be more satisfactory to them in the end if they were encouraged to forward their specimens to or consult a specialist in pathology whenever in difficulty.

The author of this book insists upon the use of a number of somewhat expensive instruments in carrying out post-mortem examinations. "One should make a practice of the constant use of these knives, and avoid the tendency to substitute a butcher knife, since systematic post-mortem work is not butchery." There are no doubt a good many people with actual practical knowledge of veterinary post-mortem work who will consider this remark somewhat irrelevant. At all events, the dexterity with which a skilled slaughterman can eviscerate and display the organs of a carcase should, at least, create some degree of envy in those who often pose as experts in pathology and yet witness a post-mortem examination quite passively with gloves and stick in hand, and fear to soil their clothes or fingers. Efficiency in the art of cutting up dead bodies, aimed at by both slaughterman and post-mortem technician, though, of course, not with the same object in view and hence not carried out on similar lines, can indeed be gauged by observing the agility with which either operator steels his butcher's knife before he touches the carcase. Both appreciate the value of a *sharp* knife in the first place, it does not so much matter about the type of knife. The skilled post-mortem operator, however, in addition requires keen eyes, sensitive fingers, and a command of language such as will enable him to describe with accuracy the manifold changes in form and appearance taken on by organs and tissues as the result of disease.

In many places it strikes one that the author is somewhat dogmatic in his directions. One is given instructions with regard to the "correct

method" of exposing certain tissues and the "proper way" to hold a knife. Surely, here, the words "correct" and "proper" are not used in their strictest sense. He must mean that these particular methods were found most serviceable in his hands. The end in view in all cases would be to display organs with least disturbance to the relations of adjacent organs not yet examined and one can easily imagine that this could be attained by various individuals after some experience with equal degrees of efficiency by the employment of different methods. In this connection one is reminded of the loose way in which terms "correct" and "proper" are applied to dress and etiquette; here they certainly do not invariably imply a consummate degree of utility.

The development of skill in method or technic is largely individual or personal and thus must be left considerably to the imagination. After having obtained a good foundation in anatomical knowledge the enforcement of tedious text-book descriptions of post-mortem technic alone is not likely to create much enthusiasm in the mind of the student. One can recall the ennui felt by many students when this particular subject was dealt with in a few concise lectures. Nothing is likely to replace the energy and insistence of the teacher in the production of an absorbing interest in a subject which, to the uninitiated, is malodorous, repugnant.

As the title of the book suggests, the technic or method of exposing the organs in a dead body is primarily dealt with. Very little space is given to the interpretation of the changes observed. Where such remarks are given one finds a few vague, hesitating phrases and looks in vain for their amplification. For example, in dealing with the changes indicating the time that may have elapsed since an animal's death the author says:—"Rigor mortis begins immediately after death in some cases, and only after four to twenty-four hours in other conditions." What are those conditions? Again, he says that "the factors of description should be followed closely in dealing with the liver," and adds:—"On section a nutmeg appearance is commonly seen in degenerative processes, and in passive congestion blue blood is contained and runs from the cut surface." One would not gather from this that a passively congested liver and a nutmeg liver are synonymous terms.

The text is profusely supplemented with illustrations, most of which are quite good. Some, however, are extraordinarily crude; a cursory view of fig. 94 might lead one to mistake it for a reproduction of some weird mountain scenery if the legend underneath had not acquainted one with the true fact, namely that it was the head and neck of an ox with the skin of the right side removed.

The book is well printed on good paper and the publisher's work throughout has been well done.

J. T. E.